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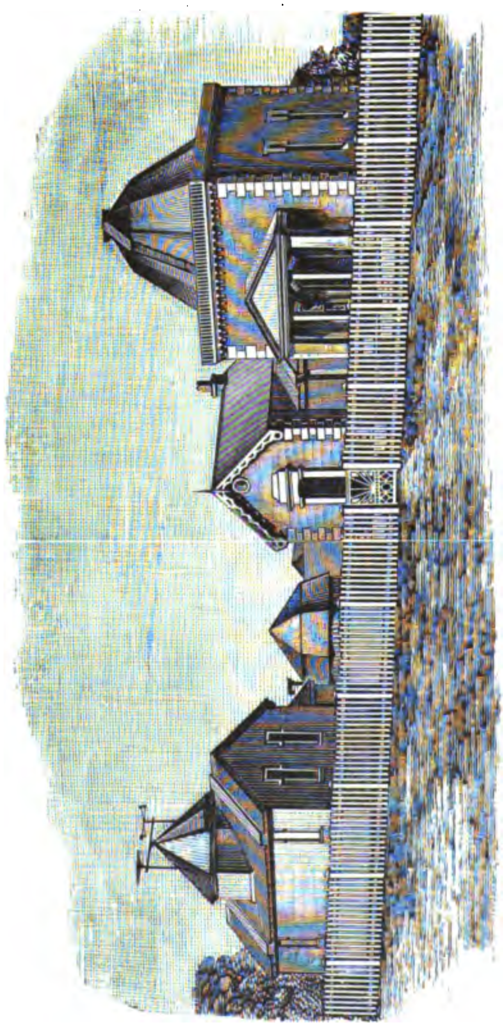

HISTORY AND DESCRIPTION

—OF—

MR. TEBBUTT'S OBSERVATORY,

120959

WINDSOR, NEW SOUTH WALES,

—BY—

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of N. S. Wales; and Corresponding Member of the Ethnographic Institute, Paris, and of the Queensland Branch of the Royal Geographical Society of Australasia.

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CONTENTS.

HISTORY AND DESCRIPTION

OF

THE WINDSOR OBSERVATORY.

At the eastern extremity of the municipal town of Windsor lies the Peninsula Estate, a tract containing about 250 acres of the richest alluvial land. It is so called because it is nearly surrounded by the courses of the Hawkesbury River and its tributary the South Creek at their confluence. On a hill situated a little south-west of the middle of the Estate, and whose summit is about fifty feet above the local mean tidal level, stands the residence of the author, with the two Observatories now to be described. Occasional astronomical observations, necessarily of a rough character, were made by him at his residence from 1854 to 1864, the instruments employed being only a sextant, an artificial horizon, a telescope of $1\frac{5}{8}$ inches aperture, and a common but excellent eight-day clock with seconds pendulum. These were employed chiefly for the purpose of self-instruction and for providing gratuitous information of a popular character for the daily newspapers. To these instruments were added a refracting telescope by Jones, of $3\frac{1}{4}$ inches aperture and 48 inches focal length in November, 1861, and an excellent eight-day half-seconds box-chronometer by Parkinson and Frodsham, No. 1042, in April, 1864. At the close of 1863 a small observatory was erected on the western side of his residence, the walls being constructed of pine and the roof covered with slates. The building comprised a transit-room, with two meridian piers and their corresponding openings in the walls and roof, and likewise a prime vertical room. The local mean time was

determined by means of a transit instrument made expressly for the observatory by A. Tornaghi, of Sydney, and mounted in September, 1864. The telescope is supported between the pivots, and originally had an object glass of 2·1 inches aperture and 20 inches focal length. The object glass was broken in June, 1874, and was replaced by another of two inches aperture and a greater focal length. The setting circle is affixed to one end of the axis of the transit. The graduated limb is of silver and $5\frac{1}{2}$ inches in diameter; the divisions are each equal to 20′, and are subdivided by opposite verniers to 20″. The distance between the pivots is 12 inches. The instrument was originally provided with a heavy metal stand, similar to that belonging to the Uckfield Observatory and represented on page 653 of Chambers' *Descriptive Astronomy*, Ed. 1867. This stand was firmly secured to the eastern pier and was thus employed till a double pier was erected at the western end of the building in 1867. The instrument was now provided with V's secured immediately to the stone caps of the pier, one adjustable for level and the other for azimuth. Beneath a trap door in the floor of the building the main body of the pier supported a trough of mercury employed in connexion with a Bohnenberger eyepiece and a level for determinations of collimation error. The metal stand before mentioned was subsequently transferred to the prime vertical pier for latitude observations and again restored to its original place on the eastern pier. The transit system originally consisted of five threads crossed at right angles by two other threads about 2′ apart. The equatorial distances of the threads from the mean of the threads in mean time, are according to the latest determinations:—A = +33ˢ·593, B = +16ˢ·606, C = +0ˢ·179, D = −16ˢ·922, E = −33ˢ·456. The letters are in the order of a star's transit above the pole with the setting circle east. The threads were accidentally destroyed in November, 1867, but were at once replaced by the maker with another system consisting of seven threads. The latest determinations of the equatorial distances in mean time of the new threads from the middle thread gave the following results:—

I	II	III	V	VI	VII
+50ˢ·793	+32ˢ·744	+16ˢ·277	−16ˢ·138	−34ˢ·006	−51·471
+50·176	+32·439	+16·080	−15·903	−33·649	−50·846

the first set corresponding to the old and the second to the new object-glass. The telescope has four eyepieces, namely, an ordinary positive eyepiece, a diagonal eyepiece, and two Bohnenberger eyepieces. It was originally furnished with a striding level divided to tenths of an inch, each division being equal to 15″·9. In reading this level the divisions were sub-divided by estimation to tenths. In December, 1875, a more delicate level, the workmanship of Troughton and Simms, was supplied by the Messrs. Flavelle Bros., of Sydney, the value of each division being 1″·1. The pivots of the transit instrument, so far as can be determined by means of the level, are not perfectly cylindrical, and the circle pivot is much smaller than the lamp one. Various corrections for inequality of pivots have been employed and the most recently adopted value is 2″·8. A lamp was originally provided by the maker for the illumination of the transit threads. Owing, however, to some defect in the adjustment of the reflector in the telescope tube, the arrangement has never been satisfactory. The illumination was therefore effected by means of a circular concave reflector attached to a ring on the object end of the telescope. The transit instrument is readily transferred from one set of V's in the meridian to another set in the prime vertical. On the bank of the South Creek, south of the Observatory, stands a meridian mark corresponding to the western or double pier before described. A stout iron-bark post is sunk perpendicularly into the ground to the depth of about five feet, its top being nearly level with the northern sloping surface of the bank. About six inches below the top a piece of white porcelain is let into the post, and over this is secured a plate of copper painted black, with a circular hole in it about a quarter of an inch in diameter. The porcelain is thus seen through the perforation from the Observatory as a small white spot on a black ground. This spot long served as a meridian and collimating mark for the transit instrument, its centre from the most recent observations being 7″·7 east of the meridian. From September, 1864, to September, 1879, the chronometer was regulated to mean solar time. In computing the mean times of the transits of the clock stars, the sidereal time at Greenwich mean noon, as given in the Nautical Almanac, was diminished by 1m. 39·10s., the correction correspond-

ing to the adopted longitude, 10h. 3m. 15·7s. E. This value of the longitude depends on that derived for the Sydney Observatory, (See Sydney Ast. and Met. Obs., 1861, p. 82.), combined with an approximate determination by telegraph of the difference between Sydney and Windsor. Notwithstanding the imperfections of the instrumental means, every precaution was taken in the work of observation so that the error of determination of the local mean time, from a set of transits on any evening, could hardly exceed half a second. A small octagonal tower rising from the centre of the Observatory, and covered by a conical revolving roof, accommodated the $3\frac{1}{4}$ inch refractor already referred to. It was mounted by the author himself in 1864, according to the Sissons or old English method, and with sufficient accuracy to enable him to identify stars of comparison. It has a finder, and had originally six eyepieces, namely, one terrestrial or erecting eyepiece and five negative eyepieces with magnifying powers ranging from 30 to 120 diameters. It was furnished with two ring-micrometers by Tornaghi, and with this telescope all the extra meridian observations were made till the acquisition of a $4\frac{1}{2}$ inch equatorial in June, 1872. In 1874, a circular building of pine, twelve feet in diameter, was erected a few yards south-east of the Observatory already described, for the temporary reception of the latter instrument. This telescope was purchased from Anthony Hordern, Esq., of Sydney, for whom it was made in 1870, by Cooke and Sons, of York, but was then unprovided with micrometers of any kind. Its object glass has a clear aperture of $4\frac{1}{2}$ inches and a focal length of 70 inches. It is mounted according to the Fraunhofer method and is adjustable to any latitude. When it came into the possession of the writer it was mounted on a firm wooden tripod, but was at once transferred to a temporary wooden platform in the equatorial tower of the Observatory. In August, 1874, it was removed from its temporary position to the circular building above mentioned. The polar axis and the socket or bearing of the declination axis are formed of one piece of metal. The telescope, which carries a finder of $1\frac{3}{8}$ inch aperture and 15 inches focal length, is secured in its cradle at one extremity of the declination axis and at the other extremity are the declination circle and counter-

poise. At the lower or north end of the polar axis is the hour circle, five inches in diameter. It has a double set of divisions on its edge, and when clamped revolves with the polar axis, and when unclamped is revolved on the axis by means of a milled head. Above this circle is a fixed vernier whose zero is in the meridian, and below it is another circle fixed to the polar axis, not graduated, but carrying another vernier whose zero coincides with that of the upper vernier when the telescope is in the meridian. The hour circle is divided on brass to two minutes of time, and these divisions are again read off by a microscope and vernier to five seconds. The declination circle is five and a half inches in diameter and is divided on its brass edge to 30′ and subdivided by two verniers to single minutes. The graduation expresses declination. The telescope is provided with the usual arrangements for clamping and slow motion in right ascension and declination. It had originally two diagonal eyepieces, one a Cooke first surface reflexion prism and the other a Herschelian reflector, also a transit eyepiece, a comet eyepiece, a terrestrial eyepiece, and six negative eyepieces with powers of 55, 80, 120, 180, 265 and 400 diameters, and the usual dark glasses for observing the sun. The two ring-micrometers formerly employed with the $3\frac{1}{4}$ inch refractor were at once adapted to the instrument. In April, 1879, a position filar micrometer and apparatus for illuminating the threads in a bright field, were received from the Messrs. Cooke, through the Messrs. Flavelle, of Sydney. The position circle is about $3\frac{1}{2}$ inches in diameter and is divided on silver to single degrees and by opposite verniers to tenths of a degree. The micrometer screws each carry a single thread, their heads being divided on silver into 100 equal parts. An inner brass circle registers the number of whole turns of each screw. One of the threads is brought into the axis of collimation of the telescope and usually regarded as fixed and therefore kept at a constant reading. One revolution of the adopted moveable screw is, according to the best determination from transits of circumpolar stars, equal to 29″·688. This screw has been carefully tested at every revolution throughout its length and found to be satisfactory. The position threads consist of two 14″ apart and one of them is employed as the transit thread in differential observations of

right ascension. The exact perpendicularity of these threads to the declination threads, as well as the mutual parallelism of these latter threads themselves, has been carefully verified. The micrometer is furnished with four eyepieces having powers ranging from 90 to 325 diameters. The illuminating lamp is suspended in a crutch affixed to the side of the telescope tube, and is provided with the proper arrangement for insuring its constant verticality and for colouring the light. The illuminating arrangement has always given complete satisfaction, but there being no means of exhibiting bright threads on a dark field, all faint objects were until the close of 1881 observed by means of the ring-micrometers previously referred to. It is, however, well known to astronomers that it is only under certain conditions which cannot always be secured, that differential measures with this form of micrometer yield satisfactory results. Since 1881, the use of the ring, except in one particular instance, has been abandoned, and for the observation of faint objects a square bar-micrometer has been substituted. This micrometer, which was made by the Messrs. Cooke, was received at the close of April, 1882. It is similar to that designed by Graham, and described on page vi of the Introduction to "Cooper's Catalogue of Ecliptic Stars." At the request of the author, however, threads were stretched between the opposite angles of the square to serve for ready and accurate orientation of the micrometer. The lengths of the diagonals reckoning from the intersections of the middle lines of the bars is, according to numerous careful observations of pairs of well determined stars, equal to 1522″·8. It was found that when the adopted declination thread was made coincident with a parallel of declination there were errors of difference of right ascension amounting to several tenths of a second of time in the case of stars whose difference of declination was considerable. A thorough investigation of the errors was made and a table formed for facilitating the calculation of the corrections of differential right ascension. No appreciable error is experienced in the determinations of differential declination. It is found that observations with this form of micrometer are more convenient and reliable than those with the ordinary ring. All the extra-meridian observations involving measurement, from 1873

down to 1886, have been made with the equatorial just described.

In 1879, a substantial Observatory of brick was erected a few yards south-west of the old building. From the centre of a large room at its west end rises a pyramidal pier of brick and cement which passes through the ground floor and a floor above. To this pier the $4\frac{1}{2}$ inch equatorial was transferred at the close of August, 1879. The instrument has remained there down to the present time and is protected by a galvanized-iron roof revolving on ten wheels on a circular plate faced with iron. The opening in this roof extends from horizon to horizon and is closed by six shutters, two of which open outwards and the others inwards. The apartment under the equatorial room serves as an office and computing room. On the south side of this apartment is the prime vertical chamber with its pier, and on the eastern side the meridian transit room for time observations. The meridian room is furnished with an excellent transit-instrument made for the Observatory by the Messrs. Cooke, and mounted on a substantial pier in September, 1879. The instrument is of that form which has the telescope between the pivots and is mounted on a heavy metal frame standing on the pier, the whole frame being adjustable for level and azimuth. The object glass has a clear aperture of three inches and a focal length of thirty-five inches. The setting circle is of brass with a graduated limb of silver about five inches in diameter. It is secured to the eye end of the telescope and is supplied with a level and two opposite verniers read off by microscopes. The divisions of the limb are 20′ and these are subdivided by the verniers to 20″. The readings are zenith distances. The telescope has three ordinary positive eyepieces with powers of 45, 70, and 90, and a diagonal and Bohnenberger eyepiece, with powers of 60 and 30 respectively. The level is a delicate one with a radius of curvature of about 1130 feet, and its divisions are on the tube and extend as far as fifty-two each way from the centre. Each division has been found equal to 0″·8. By means of the level, which is a striding one, the inclination of the axis of the transit-instrument can be measured between the limits of 25 and 154 degrees of zenith distance. The pivots are sensibly cylindrical and equal, and the distance between them is 18

inches. The transit system consists of five threads designated as A, B, C, D, E, in the order of transit above the pole when the clamp is east. The equatorial distances of the four outer threads from the middle thread in mean and sidereal time have been recently determined as follows :—

Threads.	Mean Time.	Sidereal Time.
	s.	s.
A	+19·455	+19·508
B	+9·759	+9.786
D	−9·971	−9·998
E	−19·592	−19·646

The reduction for a complete observation of an equatorial star at the upper culmination, clamp east, is therefore − 0·070s. The threads are illuminated by a lamp standing on a shelf near one of the pivots. The light falling on a lens in one of the pivots passes down the hollow conical axis of the transit and is brought to a focus on a small reflector in the middle of the central cube, thence it proceeds down the tube to the transit system. The piers of the equatorial and transit-instruments are substantial, and are remarkably free from sudden fluctuations of level considering the nature of the foundation, which consists of clay and loam. Both piers are built on a substratum of pitch and tar to prevent the rise of damp. It is remarkable that from April, 1882, to May, 1885, the eastern pivot of the transit-instrument gradually rose, so that on several occasions during that period it was found necessary to lower the pivot in order to keep the inclination within measureable limits. The following is a record of the adjustments made: —April 29, 1882, 13″·3 ; June 15, 1882, 10″·9 ; September 14, 1883, 9″·6 ; February 26, 1884, 15″·9 ; April 8, 1884, 12″·8 ; July 31, 1884, 5″·6 ; January 30, 1885, 7″·8 ; March 14, 1885, 15″·4 ; April 23, 1885, 16″·9 ; May 12, 1885, 8″·5. Their sum is 116″·7. Subsequently to the last mentioned date the western pivot has been on the whole rising. Thinking these changes might be due to a general oscillation of the hill on which the Observatories stand, I made a series of simultaneous observations of the level errors of the two transit-instruments, the one in the old and the other in the new Observatory. Although the changes of level in the two instruments followed the same law for a time they ultimately became discordant. The cause of change for each instrument must therefore be an immediate local one.

I may remark that one or more sets of level readings are taken on every evening when transit observations are made for time. There is no micrometer in connexion with the transit threads, but the collimation of the middle thread is usually kept perfect by viewing periodically by reversal the slightly inclined middle thread of the two-inch transit-instrument mounted on a pier a little north of the transit room. On some few occasions the error of collimation has been determined by observing the lower transit of a circumpolar star over two of the side threads with the clamp alternately east and west, and on other occasions by means of the level and the Bohnenberger eyepiece. The adjustment for collimation has proved to be of a pretty permanent character. The azimuth error is deduced either from transits of β Hydri and β Chamæleontis at opposite culminations, from those of a star in high south declination and one near the equator, or occasionally from those of a high and low star north of the zenith. This error is also pretty constant. The reductions have throughout been effected by means of Mayer's well known formula, namely :—

$$\text{Sum of Instrumental Corrections} = \frac{b \cos Z}{15 \cos \delta} + \frac{c}{15 \cos \delta} + \frac{a \sin Z}{15 \cos \delta}$$

a, b, c, being the azimuth, level and collimation constants respectively and δ, Z the declination and zenith distance of the star observed. The corrections for all stars north of the zenith have recently been derived from a carefully calculated MS. Table whose arguments are each degree of declination from $-33°$ to $+56°$, and the values of a, b, c, for every second of arc from 1 to 15. Star-transits south of the zenith are reduced by means of a MS. Table of ordinary factors for every degree of declination except in cases of very high south declination, when special calculations of the corrections are made. The timekeeper of the Observatory has been either the old Parkinson and Frodsham chronometer before referred to, or another excellent one by John Poole, obtained in November, 1882, and bearing the number 2962. These, until the close of 1885, were regulated to mean time, but subsequently the first-named instrument has been regulated to sidereal time. Since a more accurate determination of the longitude was obtained, the calculations of the mean times of transit of the clock stars have been made by employing -1m. 39·12s. as the correc-

tion of the sidereal time at Greenwich mean noon. These calculations have been checked by the use of the other quantity in the Nautical Almanac known as the mean time of transit of the First Point of Aries, the correction for this value being +1m. 38·84s. Since 1885, however, the sidereal chronometer has been employed as the transit chronometer. For time determinations, the usual clock stars of the British Nautical Almanac have as a rule been employed, the only additions being a few occasionally from the moon culminating list. For azimuth determinations, circumpolar stars from the Melbourne Catalogue for 1870 have likewise been occasionally adopted. On the eastern side of the transit-room is a fire-proof apartment sometimes used as an office and computing room. It also contains the astronomical library which is gradually being enriched by works of necessary importance to the practical astronomer. A complete list of the scientific works in the library is given further on, and it will be observed that it chiefly comprises the gifts of eminent astronomers and well-known public institutions. The presentations to the library have for the most part been acknowledged by letter, but the author desires thus publicly to express his gratitude to those institutions and friends who have so kindly recognised and encouraged his labours. In his isolated position as a student of astronomy such recognitions are particularly encouraging. It now remains to speak of a very important addition to the instrumental equipment of the Observatory. This consists of a fine equatorial refractor of eight inches clear aperture, and 9 feet 7 inches focal length. It was constructed in 1882, by Grubb, of Dublin, and imported by the late Dr. Bone, of Castlemaine, Victoria. On the death of Dr. Bone, the instrument was sold to the writer for the sum of £400, or about two-thirds of the original cost. The telescope reached the Observatory on May 20th last year, and on the 16th of the following month, was permanently mounted in the circular building formerly accommodating the 4½ inch equatorial. The pillar supporting the equatorial consists of two massive hollow cylinders of cast iron, one standing on the other. The lower casting is securely bolted to a pier of brick and cement rising from a foundation about nine feet below the floor. The upper casting is bolted to the lower one, but admits at the same time of

a small azimuthal adjustment by means of a tangent screw. To the upper cylinder is secured another massive casting containing the socket for the polar axis: it also contains the clock, whose driving weight is within the cylindrical pillar. This casting consists of two parts fitted in such a way as to admit of the usual adjustment for latitude within a very wide range. The mounting is that known as the Fraunhofer or German. The telescope tube is in three parts and of rolled steel. The hour circle is at the lower extremity of the polar axis, and the declination circle next to the telescope cradle, being respectively 8·6 and 13·0 inches in diameter. They are divided, the former to 2 minutes of time and read off to 10 seconds by the vernier, and the latter to 10′, read off by opposite verniers to 30″. The latter is very conveniently read off from the eye end of the telescope by means of a tube with lenses and a prism. The illuminating lamp is suspended at the counterpoise extremity of the declination axis. The light passing up this hollow axis and falling on a set of reflectors in the telescope cradle, serves for illuminating the micrometer threads, the graduated limb of the declination circle and a transparent position circle at the eye end of the telescope. The telescope has a filar micrometer of the best description, consisting of a single position thread and two moveable distance threads. The micrometer screw-heads are each divided into 100 equal parts, and their revolutions are registered by suitable scales to the extent of 80 whole turns. The thread carried by screw A is adopted as the fixed thread and is usually kept in the collimation axis of the telescope, while distances are measured with screw B, one revolution of which has been found to be equal to 17″·869. This micrometer has five positive eyepieces magnifying 74, 96, 112, 132 and 168 diameters. The telescope has also a Dawes solar eyepiece and four negative eyepieces whose magnifying powers are 131, 175, 224, and 350. The ring, square-bar and filar micrometers employed in connexion with the $4\frac{1}{2}$ inch equatorial have recently been adapted to this instrument. The powers of the last mentioned micrometer thus adapted are 138, 230, 299, and 683, and one revolution of the adopted moveable screw is found to be equal to 18″·026. It is found necessary to use the bar-micrometer when faint objects are to be observed, as there are at present no means

for illuminating the micrometer threads in a dark field. The reader will at once perceive that the new telescope forms a very valuable addition to the appliances of the Observatory, and it has not been idle since it was installed.

From what has been written it will be seen that the instrumental equipment of the Observatory is of a modest character. It has, however, been sufficient to occupy the attention of the proprietor, and has doubtless rendered some service to the cause of astronomy. At the close of this description will be found a list of all the papers contributed by him to the scientific institutions of this Colony and of the Northern Hemisphere. He considers it quite unnecessary to publish the large mass of observations in the Colony, as they have already appeared in the papers referred to and are to be found in the library of every Observatory. As an interesting memento of his work, he also adds a list, which cannot be far from complete, of his popular contributions to the colonial daily press, from 1854 down to the present time. These contributions have been published from time to time in the hope of creating a practical interest in the science. It will be seen from the list of papers that the author's speciality is cometary astronomy, and in connexion with this circumstance it may be mentioned that in the year 1882, a request was made by the Scientific Society of Boston that he should use his influence for the formation of an Australian Corps of Comet Seekers, similar to that in the United States. A club of this kind has existed for some years past in that country, and nearly all the honours in recent comet discovery have been carried off by it. A considerable portion of the southern heavens is, however, shut out from the examination of northern observers, and it was on this account that the Society recommended the formation of a corps in Australia. With kind words of encouragement from friends in England he proceeded to the task, but it was unfortunately one which ended in disappointment. Much time was spent in correspondence and in the preparation of regulations for the work, but although many gentlemen were written to, only two promised to join. These were residents of neighbouring colonies. One of them carried on the work for a short time, but the other does not appear to have done anything. Although there are several gentlemen in the Colonies

possessed of telescopes adapted for ordinary amateur work, the idea of systematic observation, which alone can be of any benefit to science, does not present itself to their minds. The proposal for the formation of an association of comet seekers was ventilated at one of the meetings of the New Zealand Philosophical Society, but the discussion resulted merely in the suggestion that the Government should establish an astronomical observatory in the island. It is true that in our own Colony we have a Government Observatory furnished with the finest astronomical instruments, but in addition to this circumstance it is well that the improvement of our astronomical knowledge should become as widely as possible the object of private enterprise. When we consider our extensive seaboard and the position which we are expected to occupy as a great maritime nation, it seems strange that astronomy is not more widely cultivated amongst us. In a paper written for the *Industrial Progress of N.S. Wales*, 1870, the author expressed his opinion that this lamentable state of things was in some measure due to the fact that instruction in the elements of the science was almost wholly neglected in our educational institutions. How differently is the science regarded in the United States. There not only the universities embrace astronomy in their curriculum, but almost every college has its little observatory. Private observers are also abundant. Now that we are about to celebrate the first centenary of our existence, let us hope that an important change may take place in our attitude towards the noblest of sciences.

A brief description of the Observatory and its instruments having now been given, it remains to say something with reference to the work itself. The list of papers which follows this description will afford a very good idea of the results achieved. It may be stated that all the astronomical observations without exception have been made by the author himself, and previously to 1881 he executed unassisted all the reductions of these observations. In the reductions since 1880 he has been enabled to obtain the occasional assistance of the following persons:—Messrs. A. O. Powys, of Sydney; Mr. M. L. Allen, Public School Teacher of Woodhouselee, near Goulburn; Miss M. Arnold, Pupil Teacher, and Masters A. Berkelman and M. McMahon, pupils of the local Public School. Assistance has also been

rendered by his own son. The reductions were made according to forms prepared by the author, and every precaution was taken against both systematic and accidental errors. Many parts of the calculations were performed in duplicate. The more intricate and important portions of the reductions have fallen to the author's own lot, and in every case from 1858 to the present time the calculation of the cometary orbits has devolved solely upon him. In addition to the astronomical work, daily meteorological observations have been kept up with few interruptions since 1862. All these observations with some few exceptions have been made by the author. The daily reductions have also been performed by him, but the calculations of the monthly sums and means have been made in duplicate by himself, his son and various assistants. The results of these observations to the close of 1885 have been published in five parts and distributed among the various scientific institutions of both hemispheres. For a description of the meteorological instruments the reader is referred to the works thus published.

A woodcut, which is a faithful copy of a photograph of the Observatories taken from the north-west in August, 1880, forms the frontispiece to this little volume. The geographical position of the establishment has been pretty accurately determined. The longitude has been derived firstly from lunar distances and lastly from moon-culminations, lunar occultations of stars, and telegraphic signals exchanged with the Sydney Observatory. The latitude, originally obtained from numerous meridian altitudes of the sun and principal stars taken with a sextant, has more recently been deduced from prime vertical observations made with the two transit-instruments. The most reliable coordinates are as follow:—

Longitude $=$ 10h. 3m. 20·8s. E. of Greenwich.
Latitude $= 33^\circ\ 36'\ 30''\!\cdot\!8$ South.

The former has been derived by Professor Auwers in his very elaborate investigation entitled, "Bestimmung eines fundamentalen Meridians für Australien durch absolute Methoden," in the *Astronomische Nachrichten*, Band CX, p. 289; the latter is the result of a very careful series of prime vertical observations with the 3 inch transit-instrument in 1881. See an abstract of the author's investigation

in the *R.A.S. Monthly Notices*, Vol. XLIV. p. 101. The Observatory being now regarded as a fundamental point in the Australian system of longitudes, Professor Harkness, of Washington, has recently suggested the great importance of determining with all possible accuracy, by means of the electric telegraph, the difference of longitude between it and the Government Observatories at Sydney and Melbourne, two other well determined points in Australia. At the request of that well-known astronomer, this work has recently been carried out, and the results promise to be exceedingly satisfactory. In concluding this brief description of the Observatories and their appliances, it may be added that a considerable portion of the results represented in the accompanying list of papers has been already utilized, and the work has proved of sufficient importance to admit of Windsor being placed in the list of Observatories in the British and American Nautical Almanacs, the Connaissance des Temps, and the Berliner Astronomisches Jahrbuch.

September 1st, 1887.

PAPERS read before the Royal Astronomical Society of London, 1862—1887, and published in the Monthly Notices of the Society, Vols. XXIII to XLVII, also Publications in the Astronomische Nachrichten, Vols. LIX to CXVII.

[Note :—The Titles of the Papers are amended so as to express more accurately the contents, and are printed in Roman capitals. The names of the Journals in which the papers are published are in Italics, and a brief notice of the contents of each paper is given after the reference.]

OBSERVATIONS AND ORBIT-ELEMENTS OF COMET III (SWIFT), 1862. *Ast. Nach. Band* LIX. No. 1402. *p.* 157. The observations consist of differences of apparent right ascension and north polar distance of the comet and comparison stars obtained with a ring-micrometer on the 3¼ inch refractor. on August 31, September 1, 2, 6, 10, 14, 16, 1862, and the elements are based on the positions of the first three dates.

OBSERVATIONS AND ORBIT-ELEMENTS OF COMET III (SWIFT), 1862 :—*R.A.S. Monthly Notices, Vol.* XXIII. *p.* 95, *and Ast. Nach., Band* LIX, No. 1404, *p.* 183. The observations are similar to those above described and were made on September 19, 25, 26, October 3, 9, 12, 14, 1862, and the elements are deduced from more extended observations than those from which the elements in the preceding paper were derived.

OBSERVATIONS OF COMET II (TEMPEL), 1864 :—*Ast. Nach., Band* LXIII. No. 1497, *p.* 141. These consist of apparent right ascensions and north polar distances obtained from ring-measures with the 3¼ inch refractor on August 14, 15, 16, 1864, and uncorrected for parallax. The mean places of the comparison stars for 1864·0, with the authorities, are added.

OBSERVATIONS AND ORBIT-ELEMENTS OF COMET II (TEMPEL), 1864 :—*R.A.S. Monthly Notices, Vol.* XXV. *p.* 43, *and Ast. Nach., Band* LXIII. No. 1503, *p.* 237. The positions of the Comet consist of apparent right ascensions and north polar distances obtained as in the paper last described and uncorrected for parallax. The dates of observation are August 18, 19, 21, 25, 26, 27, 30, September 2, 3, 4, 6, 11, 12, 13, 15, 16, 17, 1864. The mean places of the comparison stars, with the authorities, are given. The elements are derived from the positions for August 14, 25, and September 4, corrected for aberration and parallax.

Observations of Comet II (Tempel), 1864:—*R.A.S. Monthly Notices, Vol.* XXV. *p.* 194, *and Ast. Nach., Band* LXIV. No. 1517, *p.* 79. These observations are for September 19, 20, 25, 1864, and conclude the series for Windsor. They consist of apparent right ascensions and north polar distances uncorrected for parallax. The mean places of the comparison stars are given and the authorities whence derived. The Windsor observations of this Comet were combined by Dr. Kowalczyk, of Warsaw, with those made at various other places in a definitive investigation of the orbit. See "Ast. Nach., Band LXV. No. 1546, p. 145."

Observations of Comet I, 1865, (Great Southern Comet):—*R.A.S. Monthly Notices, Vol.* XXV. *p.* 195, *and Ast. Nach., Band* LXIV. No. 1526, *p.* 221. The observations were made with a ring-micrometer on the 3¼ inch refractor and consist of apparent right ascensions and north polar distances uncorrected for parallax. The mean and apparent places of the comparison stars, together with the authorities for the former, are added. The dates of observation are January 30, February 3, 4, 6, 8, 9, 14, 15, 1865.

Observations of Comet I, 1865:—*R.A.S. Monthly Notices, Vol.* XXV. *p.* 258, *and Ast. Nach., Band* LXIV. No. 1529, *p.* 269. The results are similar to those in the last paper, and are for February 17, 22, 23, 24, March 4, 16, 17, 18, 20, 1865, in the former Journal and for the same dates, except March 20, in the latter.

Orbit-Elements of Comet I, 1865:—*R.A.S. Monthly Notices, Vol.* XXV. *p.* 271, *and Ast. Nach., Band* LXV. No. 1541, *p.* 79. The elements are derived from the Windsor positions for January 30, February 8, 15, 23, and March 18, corrected for aberration and parallax. As these results formed till recently the closest approximation yet published, they have been transferred to the Comet Tables in the various popular works on Astronomy. A definitive investigation of the elements has, however, just been completed by Dr. F. Koerber, of Breslau.

Discovery and Observations of Encke's Periodical Comet:—*R.A.S. Monthly Notices, Vol.* XXVI. *p.* 29, *and Ast. Nach., Band* LXV. No. 1551, *p.* 237. The Comet was detected by the author with the 3¼ inch refractor on June 24, 1865, with the help of a rough calculation founded on the elements for the previous return and an assumed perihelion passage. The positions are apparent right ascensions and north polar distances for June 24, 29, 1865, uncorrected for parallax. The mean and apparent places of the comparison stars, with the authorities for the former, are added.

Observations of η Argus:—*R.A.S. Monthly Notices, Vol.* XXVI. *p.* 83. These comprise detailed unassisted-eye comparisons of the light of the variable with that of certain well-known stars on July 5, 1854; May 4, 18, 1860; January 26, June 23, July 15, 22, 24, 25, August 28, 1862; April 15, 16, May 24, 1863; March 23, April 23, May 31, July 28, 1864; and February 22, 23, 24, March 14, 1865.

Amended Orbit-Elements of Comet I, 1865 :—*R.A.S. Monthly Notices, Vol.* XXVI. *p.* 84. The elements in this paper are a slight improvement on those before communicated. They have been employed by Dr. F. Koerber of Breslau, in a discussion of all the published observations for a definitive orbit. The corrections to the Windsor provisional elements are small. See Dr. F. Koerber's "Inaugural Dissertation ueber den Cometen, 1865, I, Breslau, 1887."

Apparent Right Ascensions and North Polar Distances of Comet I. 1865 :—*Ast. Nach., Band* LXVII. No. 1593, *p.* 139. These are the final results from observations previously published for January 30, February 3, 4, 6, 8, 9, 14, 15, 17, 22, 23, 24, March 4, 16, 17, 18, 23, 1865. They are uncorrected for parallax but the necessary factors for the reductions are added. The mean and apparent places of the comparison stars are given, the former being almost wholly derived from observations made in the same year with the Melbourne transit-circle, and kindly communicated by the Government Astronomer for Victoria. These observations have been employed with the other southern observations in a definitive investigation of the orbit-elements. See remarks on the last paper.

Observations of the Total Eclipse of the Moon, 1866, September 24 :—*R.A.S. Monthly Notices, Vol.* XXVII. *p.* 84, *and Ast. Nach. Band* LXVIII. No. 1621, *p.* 203. Both contacts of the total phase and the last contact of the partial phase were observed with the 3½ inch refractor.

Observations of Eclipses of Jupiter's Satellites in 1866 and 1867 : —*R.A.S. Monthly Notices, Vol.* XXVIII. *p.* 215, *and Ast. Nach., Band* LXXI. No. 1691, *p.* 169. These comprise six disappearances of Satellite I, three of II, five of III, and one of IV, ten reappearances of Satellite I, seven of II, four of III, and three of IV. The disappearance and reappearance of Satellite III were both observed on September 15, 1866, and those of Satellite IV on October 19, 1867. The 3½ inch refractor was employed throughout.

Observations of η Argus, 1866 to 1868 :—*R.A.S. Monthly Notices, Vol.* XXVIII. *p.* 266. These are detailed comparisons of the variable made with the unassisted eye or with telescopes on February 16, March 22, June 29, July 4, December 3, 8, 11, 12, 1866; January 12, 26, March 2, April 17, May 4, July 27, December 28, 31, 1867 ; and February 26, 27, April 13, 22, 1868. They have been employed by Professor Loomis in conjunction with earlier observations in an investigation of the period and light-curve of the variable. See "R.A.S. Monthly Notices, Vol. XXIX. p. 298."

Observations of the Partial Eclipse of the Sun, August 18, 1868 : —*R.A.S. Monthly Notices, Vol.* XXIX. *p.* 2, *and Ast. Nach., Band* LXXII. No. 1725, *p.* 335. The first contact only was observed, the instrument employed being the 3½ inch refractor.

Measures of Difference of R.A. and N.P.D. of η Argus and Certain Telescopic Stars with the two-inch transit-instrument and the ring-micrometer on the 3¼ inch refractor: —(Letter to Sir John F. W. Herschel, Bart., &c.) *R.A.S. Monthly Notices, Vol.* XXIX. *p.* 296.

Observations of the Partial Eclipse of the Moon, July 23, 1869: *R.A.S. Monthly Notices, Vol.* XXX. *p.* 26, *and Ast. Nach., Band* LXXIV. No. 1776, *p.* 381. Both contacts were observed with the 3¼ inch refractor.

Observations of the Total Eclipse of the Moon, January 17, 1870: —*R.A.S. Monthly Notices, Vol.* XXX. *p.* 159, *and Ast. Nach., Band* LXXV. No. 1800, *p.* 379. In addition to the four contacts several occultations of small stars were observed with the 3¼ inch refractor.

Observations of the Partial Eclipse of the Sun, June 28, 1870:— *R.A.S. Monthly Notices, Vol.* XXXI. *p.* 83, *and Ast. Nach., Band* LXXVI. No. 1818, *p.* 283. Both contacts were observed with the 3¼ inch refractor.

Concluded Magnitudes of η Argus:—*R.A.S. Monthly Notices, Vol.* XXXI. *p.* 210, *and Ast. Nach., Band* LXXVIII. No. 1867, *p.* 297. These are the results of comparisons made with the unassisted eye and with telescopes from 1854 to the close of 1870.

Observations of Lunar Occultations of Stars, 1864—70, and of Eclipses of Jupiter's Satellites, 1868—69—70:—*R.A.S. Monthly Notices, Vol.* XXXII. *pp.* 58—61, and *Ast. Nach., Band* LXXVIII. No. 1872, *p.* 373. All the observations, except one occultation, were made with the 3¼ inch refractor. Of the occultations, 75 were disappearances and 3 reappearances. Of the eclipses, there were one disappearance of Satellite I, one of II, two of III, four reappearances of Satellite I, and two of II.

Observations of the Partial Eclipse of the Sun, December 12, 1871:—*R.A.S. Monthly Notices, Vol.* XXXII. *p.* 243, *and Ast. Nach., Band* LXXIX. No. 1885, *p.* 197. Both contacts were observed with the 3¼ inch refractor, and several sunspots were observed to be occulted. Readings of a black-bulb solar thermometer *in vacuo* were also taken during the phenomenon.

Observations of the Total Eclipse of the Moon, May 12, 1873:— *R.A.S. Monthly Notices, Vol.* XXXIV. *p.* 72. All four contacts were observed with the 4½ inch equatorial. Several occultations of small stars were also observed during the total phase.

Observations of Dark Transits of Jupiter's Third Satellite on April 1, 8, May 14, 1873:—*R.A.S. Monthly Notices, Vol.* XXXIV. *p.* 73. These observations were made with the 4½ inch equatorial, and form the subject of interesting papers by Professor Alexander and Dr. Klein in "Ast. Nach., Band LXXXIII. No. 1986. p. 273," and "Band LXXXIV. No. 2014, p. 343," respectively.

Observations of Lunar Occultations of Stars and Eclipses of Jupiter's Satellites in 1873 :—*R.A.S. Monthly Notices, Vol.* XXXIV. *p.* 421. The observations, except one occultation, were made with the 4½ inch equatorial. Thirty-eight disappearances of stars were observed. The observations of eclipses are distributed as follows :—one disappearance of Satellite IV, six reappearances of I, two of II, and one of IV.

Observations of Comet III (Coggia), 1874 :—*R.A.S. Monthly Notices, Vol.* XXXV. *pp.* 59, 110, 313, *and Ast. Nach., Band* LXXXIV. No. 2014, *p.* 341, *and Band* LXXXV. No. 2020, *p.* 49; No. 2032, *p.* 253. These are ring comparisons with the 4½ inch equatorial on August 1, 2, 6, 7, 13, 14, 18, 20, 22, 24, 25, 26, 29, September 1, 7, 8, 14, 21, 28, and October 2, 6, 7, 1874. The differential measures only are given.

On the Probable Disappearance of Two Stars of the Sixth Magnitude from the Cluster near B.A.C. 2694 :—*R.A.S. Monthly Notices, Vol.* XXXV. *p.* 126.

Observations of the Transit of Venus, December 8—9, 1874 :—*Ast. Nach., Band* LXXXV. No. 2027, *p.* 173. All four contacts were well observed with the 4½ inch equatorial. The observations occupy an important place in the investigation of the solar parallax from the British observations. See "R.A.S. Monthly Notices, Vol. XXXVIII. p. 429."

Observations of Eclipses of Jupiter's Satellites in 1873 and 1874 : —*Ast. Nach., Band* LXXXVI. No. 2041, *p.* 11. These were made with the 4½ inch equatorial, and comprise fourteen reappearances of Satellite I, six of II, two disappearances and two reappearances of III, one disappearance and three reappearances of IV. The disappearance and reappearance of III were both observed on May 11, 1874.

Apparent Right Ascensions and North Polar Distances of Comet III (Coggia), 1874 :—*R.A.S. Monthly Notices, Vol.* XXXV. *p.* 406, *and Ast. Nach., Band* LXXXVI. No. 2048, *p.* 119. The positions depend on ring-micrometer observations with the 4½ inch equatorial, extending from August 1, to October 7, 1874, previously published. The places are uncorrected for parallax. The mean and apparent places of the comparison stars are given in the latter authority, the mean places being almost all obtained with the Melbourne transit-circle in 1875, and kindly communicated by the Government Astronomer for Victoria. The paper also contains a notice of the discovery of Encke's comet by sweeping without an ephemeris on May 6, 1875. The Windsor positions of Coggia's Comet combined with all others published, were employed in 1882 by Dr. J. von Hepperger, of Vienna, in a definitive investigation of the Comet's orbit. See "Bahnbestimmung des Kometen 1874, III, (Coggia), von Dr. J. v. Hepperger, aus dem LXXXVI Bande der Sitzb, der K. Akad. der Wissensch, II. Abth. Juli —Heft. Jahrg, 1882."

Note on Comet III, 1874, and Mr. Birmingham's Supposed Variable Star in Monoceros :—*Ast. Nach., Band* LXXXVI, No. 2055, *p.* 239.

Observations of Encke's Comet and Additional Remarks on Mr. Birmingham's Suspected Variable Star :—*Ast. Nach., Band* LXXXVI. No. 2054, *p.* 223. The results for the comet are apparent right ascensions and north polar distances, derived from ring-comparisons with the 4½ inch equatorial on May 7, 9, 1875, and uncorrected for parallax. The mean and apparent places of the comparison stars, with the authorities for the former, are also given. Mr. Birmingham's supposed new star is also identified as having been observed by Lalande at the close of last century, and entered in the British Association's Edition of Lalande's Catalogue for 1800 as No. 14599.

Observations of the Lunar Occultation of Mars, August 12, 1875 :— *R.A.S. Monthly Notices, Vol.* XXXVI. *p.* 43. Both phases were observed in full sunlight with the 4½ inch equatorial.

Observations of Eclipses of Jupiter's Satellites in 1875 :—*R.A.S. Monthly Notices, Vol.* XXXVI. *p.* 100, *and Ast. Nach*, *Band* LXXXVII. No. 2070, *p.* 91. The observations were made with the 4½ inch equatorial as follows :—Satellite I, five reappearances; Satellite II, one disappearance and three reappearances; Satellite III, two disappearances and three reappearances. Both phases for Satellite II were observed on July 20, and for Satellite III on July 15 and August 27.

Observations of Lunar Occultations of Stars in 1873, 1874, and 1875 :—*Ast. Nach., Band* LXXXVII. No. 2088, *p.* 377. The observations consist of sixty-six disappearances and one reappearance, chiefly of small stars. Three of the observations were made with the 3¼ inch refractor and the rest with the 4½ inch equatorial.

Observations of the Lunar Occultations of α Virginis and α Scorpii, June 2, and July 3, 1876, respectively :—*Ast. Nach., Band* LXXXVIII. No. 2106, *p.* 287. The occultations were observed in both phases with the 4½ inch equatorial.

Observations of the Partial Eclipse of the Sun, September 17, 1876 :—*R.A.S. Monthly Notices, Vol.* XXXVII. *p.* 11, *and Ast. Nach., Band* LXXXVIII. No. 2111, *p.* 365. Both contacts were observed with the 3¼ inch refractor.

Observations of Eclipses of Jupiter's Satellites in 1876 :—*Ast. Nach., Band* LXXXIX. No. 2116, *p.* 57. These were made with the 4½ inch equatorial as follow :—Satellite I, six reappearances; Satellite II, one disappearance and four reappearances; Satellite III, two disappearances and four reappearances. Satellite II was observed in both phases on August 21, and Satellite III on June 23 and 30.

Concluded Magnitudes of η Argus from 1871 to 1876 :—*R.A.S. Monthly Notices, Vol.* XXXVII. *p.* 280.

Lunar Occultations of Stars in 1876 :—*R.A.S. Monthly Notices, Vol.* XXXVII. *p.* 434. These observations were made with the 4½ inch equatorial and consist of eleven disappearances and three reappearances. The Windsor observations of lunar occultations of stars, extending from 1873 to 1876 and comprised in this and preceding papers, have recently been turned to valuable account. They occupy a very prominent

position in an investigation by Professor A. Auwers, of Berlin, of the longitudes of Sydney, Melbourne, Adelaide and Windsor. See his paper, "Bestimmung eines fundamentalen Meridians für Australien durch absolute Methoden" in "Ast. Nach., Band CX. No. 2635-6, p. 289." This distinguished astronomer in the course of his investigation bears the following very gratifying testimony to the value of the observations :—" These observations, too, are throughout "reliable and prove the great care with which Mr. Tebbutt "has worked. I cannot omit to point out that in my ex-"perience in this branch of research, there is no second "series of observations approaching at all in extent to his, in "which, as here, not a single observation can be regarded as "faulty, and not a single error has to be rectified in the "statement." The long series of occultations thus utilized by Professor Auwers has rendered the Observatory one of the fundamental points in the Australian system of longitudes.

OBSERVATIONS OF DARK TRANSITS OF JUPITER'S THIRD SATELLITE :—*R.A.S. Monthly Notices, Vol.* XXXVIII. *p.* 73. The observations were made with the 4½ inch equatorial on March 4, April 23, July 18, 1874.

ON A NEW VARIABLE STAR IN THE CONSTELLATION ARA :—*R.A.S. Monthly Notices, Vol.* XXXVIII. *p.* 330, *and Ast. Nach., Band* XCI. No. 2178, *p.* 279.

NOTE ON THE GREAT COMET II, 1861 :—*R.A.S. Monthly Notices, Vol.* XXXVIII. *p.* 412, *and Ast. Nach., Band* XCIII. No. 2211, p. 47. This paper contains newspaper references to the author's original discovery of this comet and his approximate determination of the orbit. The facts were now put on record in the journals above cited, as the author was not, at the time of the comet's discovery, in communication with the scientific periodicals of Europe.

OBSERVATIONS OF ECLIPSES OF JUPITER'S SATELLITES IN 1877 :—*Ast. Nach., Band* XCII. No. 2189, *p.* 75. The observations were made with the 4½ inch equatorial as follows :—Satellite I, one disappearance ; Satellite II, one disappearance ; Satellite III, three disappearances and two reappearances ; Satellite IV, one disappearance. The eclipse of Satellite III on May 4 was observed in both phases.

THE TRANSIT OF MERCURY, MAY 6, 1878, AND THE LONGITUDE OF THE WINDSOR OBSERVATORY :—*Ast. Nach., Band* XCIII. No. 2212, *p.* 61. The egress of Mercury was observed with the 4½ inch equatorial. The paper contains twelve determinations for longitude from occultations of well-known stars, the moon's places being corrected by Greenwich observations.

NOTE ON BRISBANE, 6183 :—*Ast. Nach., Band* XCIII. No. 2217, *p.* 141. This star is noted as missing.

DISCOVERY OF ENCKE'S COMET, AUGUST 3, 1878 :—*R.A.S. Monthly Notices, Vol.* XXXIX. *p.* 75, *and Ast. Nach., Band* XCIII., No. 2222, *p.* 223. This is a notification of the discovery of the Comet on August 3, with its rough position for the time as deduced from observations with the 4½ inch equatorial.

Occultation of a Fixed Star by Jupiter's First Satellite:—*Ast. Nach., Vol.* XCIII., No. 2232, *p.* 379. This phenomenon was observed with the 4½ in. equatorial on October 5, 1878.

Observations of Encke's Comet in 1878:—*R.A.S. Monthly Notices, Vol.* XXXIX. *p.* 321 *and Ast. Nach., Band* XCIV., No. 2237, *p.* 71. These observations were made with a ring on the 4½ inch equatorial, and extend from August 5 to 17. The concluded apparent right ascensions and north polar distances, with the usual parallax factors or the corrections, are given. The adopted mean and apparent places of the comparison stars are added. The observations were continued to August 28, but the Comet was too faint after the 17th to afford satisfactory positions.

Discovery of Brorsen's Comet in 1879:—*R.A.S. Monthly Notices, Vol.* XXXIX., *p.* 430. This is an announcement of the Comet's discovery on February 22, with the 4½ inch equatorial by the help of Dr. Schulze's ephemeris in "Ast. Nach., No. 2220."

Observations of Eclipses of Jupiter's Satellites in 1878:—*Ast. Nach., Band* XCV., No. 2264, *p.* 119. Except in one instance the observations were made with the 4½ inch equatorial, and may be summarised thus:—Satellite I, one disappearance and twelve reappearances; Satellite II, one disappearance and three reappearances; Satellite III, two disappearances and four reappearances; Satellite IV, one disappearance and three reappearances. Both phases of the eclipse of Satellite III on November 7, were observed. Dark transits of Satellite III were observed on September 7, 14, October 20, and a similar transit of Satellite IV on August 24.

Observations of Brorsen's Comet, 1879:—*R.A.S. Monthly Notices, Vol.* XXXIX. *p.* 486, *and Ast. Nach., Band* XCV. No. 2264, *p.* 123. These consist of ring-comparisons with the 4½ inch equatorial on February 26 and March 11. The results are apparent right ascensions and north polar distances, with the usual parallax factors. The adopted mean and apparent places of the comparison stars are also given.

On the Longitude of the Observatory, Windsor, N.S. Wales:—*R.A.S. Monthly Notices, Vol.* XL. *p.* 308. The longitude is derived from twenty occultation phases, namely, seventeen disappearances and three reappearances observed from 1866 to 1876, the moon's places being corrected by observations at Greenwich, Radcliffe, and Washington.

On the Probable Variability of B.A.C. 2472:—*R.A.S. Monthly Notices, Vol.* XL. *p.* 437.

On the Longitude of the Observatory, Windsor, N.S. Wales:—*R.A.S. Monthly Notices, Vol.* XL. *p.* 440. This is a paper supplementary to that published at page 308 of the same volume, and the longitude is finally determined from twenty-three occultation phases, namely, nineteen disappearances and four reappearances. The resulting value is 10h. 3m. 21·8s. E. from Greenwich.

Observations of Eclipses of Jupiter's Satellites, July, 1879, to January, 1880 :—*Ast. Nach., Band* XCVII. No. 2307, *p.* 37. The observations were made with the 4½ inch equatorial as follows :—Satellite I, one disappearance and seven reappearances; Satellite II, three reappearances; Satellite III, three disappearances and five reappearances; Satellite IV, two disappearances and one reappearance. Satellites III and IV were observed in both phases on November 29 and September 22 respectively.

Notice of the Appearance of a Large Comet :—*Ast. Nach., Band* XCVII. No. 2309, *p.* 75. This refers to the Great Southern Comet I, 1880, but no observations of any value could be obtained owing to continued cloudy weather.

Observations of Pallas at the Opposition of 1879-80 :—*Ast. Nach., Band* XCVII. No. 2321, *p.* 269. These consist of apparent right ascensions and north polar distances on December 8, 9, 14, 17, 20, 1879, January 7, 9, 21, 1880. With the exception of one observation in R.A. with the 3 inch transit-instrument, the positions depend on the filar micrometer of the 4½ inch equatorial. The parallax corrections are added. The mean places of the comparison stars have, with two exceptions, been deduced from the Washington Catalogue of 10658 Stars for 1860, but as the stars are in rather high south declination the positions might, with advantage, be taken from Stone's new Cape Catalogue for 1880.

Orbit-Elements of Comet I, 1880 (Great Southern Comet) :—*Ast. Nach., Band* XCVIII. No. 2338, *p.* 155. The elements are deduced from the Melbourne observations of February 9, 14, 17, 1880, corrected for aberration and parallax.

Observations of the Red Spot on Jupiter :—*R.A.S. Monthly Notices, Vol.* XLI., *p.* 331. These are observations with the 4½ inch equatorial of the transit of the spot over the central meridian of the planet both by means of the filar micrometer and by estimation. The dates of observation are October 31, November 2, 7, 10, 15, 17, 24, December 1, 4, 10, 18, 30, 1880. The observations have been combined by Dr. Schmidt of Athens, with other results, in an investigation of the rotation-period of the planet. See "Ast. Nach., Band CI., No. 2410, p. 147."

Observations of Jupiter and Star No. 363 of the Washington General Catalogue for 1860 :—*Ast. Nach., Band* XCIX. No. 2365, *p.* 205. These consist of filar-micrometer comparisons of the planet and star with the 4½ inch equatorial during their close approach November 20, 1880, with the concluded geocentric places of the planet and the resulting corrections to the Nautical Almanac.

Discovery and Observations of Comet III, 1881 :—*Ast. Nach., Band* C. No. 2387, *p.* 171. This paper contains a notification of the discovery, with partially reduced filar micrometer measures for May 22, 23, 25, 27, 1881.

Observations and Orbit-Elements of Comet III, 1881 :—*R.A.S. Monthly Notices, Vol.* XLI. *p.* 442, *and Ast. Nach., Band* C. No. 2397, *pp.* 333 *and* 335. This paper contains the comet's apparent right ascensions and north polar distances for May 22, 23, 25, 27, June, 1, 2, 4, 5, 6, 8, 11, 1881, the last being derived from circle comparisons and all the others from filar micrometer measures with the 4½ inch equatorial. The parallax factors with the adopted mean and the apparent places of the comparison stars are also given. The elements are parabolic and are derived from the positions for May 22, June 1, 11, 1881, uncorrected for aberration or parallax. The Windsor observations combined with many others extending to the end of September, have been employed by M. Bossert, of the Paris Observatory, in an investigation of the elliptic elements, the resulting period of revolution being 2954½ years. See "Comptes Rendus des Séances de l'Academie des Sciences, Tome XCIII. p. 659.

Discovery of a Comet :—*Ast. Nach., Band* CI. No. 2402, *p.* 31. This Comet was detected while sweeping with the 3¼ inch refractor on September 17, 1881. It subsequently turned out to be Comet IV, (Schaeberle) 1881. Approximate positions are given for September 17, 18, 1881, from ring-comparisons with the 4½ inch equatorial.

Remarks on Dr. Gould's Observation of Comet III, 1881, June 11, (Ast. Nach., No. 2384) :—*Ast. Nach., Band* CI. No. 2411, *p.* 171. Dr. Gould supposed that he had observed another comet in the same field with the Great Comet, and this paper was written to show that the telescope at Windsor was pointed on the comet within an hour and a half of the Cordoba observation, without any second comet being seen, and that owing to the very unsatisfactory conditions for observing at Cordoba, the objects seen there were the blurred images of the stars B.A.C. 1592, 1597, near the horizon. This view has been endorsed by several astronomers.

Observations of the Transit of Mercury, November 7—8, 1881 :—*R.A.S. Monthly Notices, Vol.* XLII. *p.* 103, *and Ast. Nach., Band* CI. No. 2411, *p.* 173. The four contacts were observed with the 4½ inch equatorial, the first imperfectly and the others very satisfactorily. These results occupy a very important place in Professor Newcomb's "Discussion of the Transits of Mercury from 1677 to 1881," which forms Part VI. of Vol I. of "Ast. Papers prepared for the use of the American Ephemeris and Nautical Almanac, Wash., 1882."

Observations of Uranus :—*Ast. Nach., Band* CI. No. 2414, *p.* 223. The observations are filar-micrometer comparisons of the planet with the well-known clock star χ Leonis on March 8, 9, 12, 13, 14, 15, 1881, the telescope employed being the 4½ inch equatorial. The results are apparent geocentric positions with the concluded corrections to the Nautical Almanac. Comparisons of the apparent magnitude of the planet are also given.

Observations of Comet IV (Schaeberle), 1881 :—*R.A.S. Monthly Notices, Vol.* XLII. *p.* 263, *and Ast. Nach., Band* CI. No. 2419, *p.* 301. These are ring comparisons with the 4½ inch equatorial on September 17, 18, 19, 20, 26, 29, 30, October 1, 2, 3, 4, 5, 8, 12, 14, 15, 1881. The results are apparent right ascensions and north polar distances, to which the parallax factors are added. The mean and apparent places of the comparison stars, the former from the best available authorities, are also given. The positions furnished in this paper have been combined by Dr. Carl Stechert, of Kiel, with all other published observations in a definitive determination of the orbit. See "Definitive Bestimmung der Bahn des Cometen, 1881, IV," in Ast. Nach., Band CVIII. p. 177."

Mean Places of Lacaille's Stars compared at Windsor with Comet III, 1881 :—*Ast. Nach., Band* CII. No. 2430, *p.* 93. The star places were deduced from filar micrometer comparisons with other well determined stars, and from observations with the 3 inch transit-instrument in the meridian.

Remarks on Dr. Gould's Observation of Comet III, 1881, June 11, (Ast. Nach., No. 2384) :—*Ast. Nach., Band* CIII. No. 2468, *p.* 311. This is a rejoinder to Dr. Gould's reply in the "Ast. Nach., No. 2434" to the author's former paper on this subject. This paper is reprinted in the "Observatory," for December, 1882.

Pre-perihelion Observations of the Great Comet II, 1882 :— *R.A.S. Monthly Notices, Vol.* XLIII, *p.* 31, *and Ast. Nach., Band* CIII. No. 2468, *p.* 311. These are comparisons with a square bar-micrometer on the 4½ inch equatorial on the mornings of September 9 and 10, 1882. The results are apparent right ascensions and north polar distances, to which the parallax factors are added. The adopted mean place of the comparison star, with the usual reductions, is given. These observations with five at Melbourne and two at the Cape of Good Hope are the only data available for the determination of the orbit-elements before the perihelion passage. From a comparison of the results derived from these data by Dr. J. R. Hind, of London, M. Raoul Gautier, of Geneva, and Dr. J. Morrison, of Washington, with those deduced from post-perihelion observations, it would appear that the orbit did not suffer any sensible change by the comet's rush through the sun's coronal atmosphere.

Observations of Comet I, (Wells) 1882 :—*R.A.S. Monthly Notices, Vol.* XLIII., *p.* 58, *and Ast. Nach., Band* CIV. No. 2475 *p.* 41. These were made with the 4½ inch equatorial on June 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, July 1, 2, 3, 4, 5, 6, 7, 9, 12, 13, 14, 17, 18, 19, 22, 23, 24, 25, 1882. The comparisons from June 19, to July 7, were made with the filar micrometer, and from July 7 to 25, with the square bar-micrometer. The results are apparent right ascensions and north polar distances, to which the usual parallax factors are added. The comparison stars are forty-three in number, and their mean places as derived from the best available authorities are given for 1882·0, together with the necessary

reductions to the apparent places for the dates of the comet observations. The observations, it is understood, are in the hands of Dr. E. von Rebeur-Paschwitz for a definitive investigation of the orbit.

NOTE ON THE GREAT COMET II, 1882:—*R.A.S. Monthly Notices, Vol.* XLIII. *p.* 62. This communication treats of the Comet's visibility in full sunlight without a telescope, and of the similarity of its orbit to those of the Great Comets of 1843 and 1880. It appears that Windsor was the first station at which the comet's visibility near the sun was noted.

OBSERVATIONS OF COMET III, (BARNARD) 1882:—*Ast. Nach., Band* CIV. No. 2492, *p.* 317. These consist of apparent right ascensions and north polar distances deduced from square bar comparisons with the 4½ inch equatorial on December 2 and 8, 1882, to which the usual parallax factors are added. The adopted mean places of the comparison stars, with the reductions to the apparent places, are also given.

NOTE ON PROFESSOR NEWCOMB'S REMARKS ON THE WINDSOR OBSERVATIONS OF THE TRANSIT OF VENUS IN 1874:—*R.A.S. Monthly Notices, Vol.* XLIII. *p.* 279. This contains a reply to Professor Newcomb's remarks in the "R.A.S. Monthly Notices" for April, 1882.

OBSERVATIONS OF THE PARTIAL SOLAR ECLIPSE, NOVEMBER 10, 1882:—*R.A.S. Monthly Notices, Vol.* XLIII. *p.* 280. Both contacts were well observed with the 4½ inch equatorial. An interesting series of observations of two black-bulb thermometers, one *in vacuo* and the other *in air* were also made during the phenomenon.

POST-PERIHELION OBSERVATIONS OF THE GREAT COMET II, 1882:—*R.A.S. Monthly Notices, Vol.* XLIII. *p.* 383, *and Ast. Nach., Band* CV., No. 2504, *p.* 117 and No. 2513, *p* 263. These consist of comparisons almost wholly with the square bar-micrometer on the 4½ inch equatorial on September 28, 29, 30, October 2, 3, 5, 6, 7, 10, 12, 13, 14, 16, 19, 22, 23, 26, 30, November 3, 6, 7, 9, 10, 14, 18, 20, 22, 30, December 1 2, 8, 12, 13, 14, 15, 18, 19, 28, 29, 1882, January 1, 7, 9, 12 14, February 6, 7, 12, 26, and March 2, 1883. The comet was also observed accurately in R.A., and approximately in N.P.D., in full sunlight, with the 3 inch transit instrument on September 18, 19, 20, 21, 1882. The apparent right ascensions and north polar distances of the comet are given for each of the dates stated together with the parallax factors. The mean places of the comparison stars, seventy-six in number, deduced from the best authorities available, are also added with the usual reductions. The Windsor positions for September 8 and January 14, in conjunction with observations made at other stations, have been employed by Dr. Morrison, of Washington, in an approximate determination of the elliptic elements. It appears that all published observations of the Comet are now under discussion by Professor Howe, of the United States, for a final determination of the orbit.

Observations of Ceres at the Opposition of 1882 :—*Ast. Nach.*, *Band* CVI. No. 2530, *p.* 157. These consist of comparisons with the 4½ inch equatorial on August 10, 14, 21, 30, 31, September 1, 2, 7, 13, 15, 1882, those on September 13, with the square bar-micrometer, and the rest with the filar-micrometer. The resulting places of the planet are geocentric apparent right ascensions and north polar distances. The adopted mean places of the comparison stars are given with the usual reductions to the apparent places.

Eclipses of Jupiter's Satellites Observed in 1880—1882 :—*Ast. Nach.*, *Band* CVI. No. 2541, *p.* 323. These may be classed thus :—Satellite I, two disappearances and seven reappearances; Satellite II, four reappearances; Satellite III, two disappearances and two reappearances; Satellite IV, one disappearance. The 4½ inch equatorial was employed throughout. It is inferred by Mr. Marth, (See "R.A.S. Monthly Notices, Vol. XLIV. p. 244,") from the observation of the Fourth Satellite, that the tabular longitude of the node of this satellite requires a sensible positive correction.

Observations of the Variable Star R Carinæ, from May, 1880, to September, 1883 :—*R.A.S. Monthly Notices, Vol.* XLIV. *p.* 14. These consist of a series of careful comparisons of the magnitude of the star with stars visible to the unassisted eye and contained in the *Uranometria Argentina*, and with others which are only telescopic. The concluded magnitudes of the variable are given for 154 different dates extending over the period stated. The coordinates of the small telescopic comparison stars with reference to the variable are also given. The limits of variability of the star are magnitudes 4·3 and 9·3 and the period from maximum to maximum about 313 days.

On the Latitude of the Observatory, Windsor, N.S. Wales :—*R.A.S. Monthly Notices, Vol.* XLIV. *p.* 101. This paper contains the results of a revision of the determination of the latitude from prime vertical observations with the two-inch transit-instrument in the years 1867, 68, 69, 70, 74. The resulting latitude of the meridian transit and equatorial piers of the new Observatory based on more accurate places of the stars employed is −33° 36′ 29″·5. The paper also contains the results of a new and very careful investigation of the latitude from six well-determined stars in 1881, by means of the Cooke 3 inch transit-instrument in the prime vertical. The resulting latitude of the two piers above referred to is −33° 36′ 30″·8, which value is that now adopted.

Observations of Comet II (Ross), 1883 :—*R.A.S. Monthly Notices, Vol.* XLIV. *p.* 283, *and Ast. Nach.*, *Band* CVIII. No. 2585, *p.* 309. These are comparisons with a square bar-micrometer on the 4½ inch equatorial on January 19, 21, 22, 23, 24, 25, 27, 28, and February 2, 1884. The apparent right ascensions and north polar distances of the comet are given for the dates named, together with the usual parallax factors. The mean places of the comparison stars for 1884·0 are also given from the best authorities available together with the reductions to the apparent places for the dates of observation.

Orbit-Elements of Comet II (Ross), 1883 :—*R.A.S. Monthly Notices, Vol.* XLIV. *p.* 377, *and Ast. Nach., Band* CVIII. No. 2588, *p.* 375. This is a determination of the elements from the Windsor observations of January 19, 23, and 28, 1884, uncorrected for aberration or parallax.

Apparent Places of Comet II (Ross), 1883 :—*R.A.S. Monthly Notices, Vol.* XLIV. *p.* 444. This paper contains the places of the comet as corrected for small errors due to the square bar-micrometer. The Windsor observations have afforded a basis for a determination of elliptic elements by Robert Bryant, B.A., of London. In conjunction with other observations at Melbourne and Madras, they have also been employed both by Gen. Tennant and Mr. Bryant in the formation of elliptic elements. See " R.A.S. Monthly Notices, Vol. XLV, p. 428, and Vol. XLVII. pp. 24, and 434," respectively.

Corrections to the Windsor Right Ascensions of Comet II (Ross), 1883 :—*Ast. Nach., Band* CIX. No. 2608, *p.* 251. This paper contains certain small corrections due to the square bar-micrometer with which the observations were made.

Observations of the Comet of 1812 (Pons-Brooks) at its Return to Perihelion in 1884 :—*R.A.S. Monthly Notices, Vol.* XLIV. *p.* 445, *and Ast. Nach., Band* CX., No. 2625, *p.* 135. These are square bar-micrometer comparisons with the 4½ inch equatorial on January 13, 19, 21, 22, 23, 25, February 2, 4, 5, 8, 9, 10, 17, 22, 25, 26, 29, March 2, 7, 8, 9, 14, 21, 24, and April 1, 21, 1884, the results being apparent right ascensions and north polar distances. In the former Journal the parallax corrections based on Schulhof and Bossert's ephemerides in Nos. 2558, 2569, and 2570, of the " Astronomische Nachrichten" are given, but in the latter the parallax factors only are supplied. The mean places of the comparison stars, forty-six in number, are derived from all available authorities, and are furnished in both journals with the usual reductions to the apparent places. The Windsor positions in conjunction with the numerous other observations hitherto published are now under discussion by Schulhof and Bossert of Paris, and will, doubtless, afford valuable data for fixing the return of the Comet to perihelion about the middle of next century.

Observations of Comet II, (Barnard) 1884 :—*R.A.S. Monthly Notices, Vol.* XLV., *p.* 50, *and Ast. Nach., Band* CX., No. 2619, *p.* 39, and No. 2624, *p.* 125. These are apparent right ascensions and north polar distances derived from square bar comparisons with the 4½ inch equatorial on July 24, 27, 28, 31, August 2, 4, 6, 8, 9, 10, 11, 12, 13, 14, 16, 18, 22, 1884, with the usual parallax factors. The mean places of the comparison stars, twenty-one in number, are also given as derived from all available authorities, with the reductions to the apparent places. The positions for July 24 and August 22, have been already adopted by Professor Egbert of Dudley Observatory, U.S., in combination with observations at the Cape of Good Hope, Vienna, Arcetri and Nice, for a determination of the elliptic orbit, which turns out to be one of very

short period, namely, about 5·4 years. See "Ast. Nach., Band CXI., p. 267, and the 'Observatory' for May, 1885."

THE WINDSOR OCCULTATIONS IN DR. AUWERS' PAPER IN AST. NACH., No. 2635-6:—*Ast, Nach., Band* CXII., No. 2666, *p.* 29. This paper contains some remarks on certain of the Windsor observations discussed by Dr. Auwers in the paper referred to.

OBSERVATIONS OF CERES AND PALLAS AT THE OPPOSITION OF 1885:—*Ast. Nach., Band* CXII. No. 2672, *p.* 125. These consist of filar-micrometer comparisons with the 4½ inch equatorial of Ceres on March 14, 15, 17, 18, April 1, and of Pallas on February 10, 20, March 13, 17, 18, 1885. The geocentric apparent places of the planets are given with the adopted mean places of the comparison stars and the reductions to the apparent places.

OBSERVATIONS OF DOUBLE STARS:—*R.A.S. Monthly Notices, Vol.* XLVI. *p.* 50. These consist of measures with the position filar-micrometer of the 4½ inch equatorial of Forty-one Southern Double Stars during the period 1880-1885.

OBSERVATION OF COMET II (BARNARD) 1885:—*Ast. Nach., Band* CXIII. No. 2704, *p.* 263. The Comet was observed on July 17 only, with the square bar-micrometer of the 4½ inch equatorial.

OCCULTATIONS OBSERVED, 1877-85:—*Ast. Nach., Band* CXIII. No. 2709, *p.* 341. This paper records the observations of seventy-eight disappearances and one reappearance of stars at the moon's dark, and of two disappearances at the bright, limb. Except in one instance the observations were made with the 4½ inch equatorial.

OBSERVATIONS OF ECLIPSES OF JUPITER'S SATELLITES IN 1885:—*Ast. Nach., Band* CXIII. No. 2712, *p.* 387. The observations were made with the 4½ inch equatorial. They are all reappearances and may be classified as follows:—six of Satellite I, six of Satellite II, two of Satellite III, and one of Satellite IV.

OBSERVATION OF THE CONJUNCTION OF SATURN AND μ GEMINORUM, JANUARY 10, 1886:—*R.A.S. Monthly Notices, Vol.* XLVI., *p.* 304. This paper comprises the detailed results of twenty differential measures of the planet and star with the filar-micrometer of the 4½ inch equatorial.

OBSERVATIONS OF THE VARIABLE STAR R. CARINÆ FROM SEPTEMBER 1883, to APRIL 1886:—*R.A.S. Monthly Notices, Vol.* XLVI. *p.* 487. These comprise comparisons made on sixty dates in the interval stated, and are a continuation of the series published in Vol. XLIV. of the "Notices."

OBSERVATION OF THE LUNAR OCCULTATION OF JUPITER AND HIS SATELLITES, APRIL 16, 1886:—*Ast. Nach., Band* CXIV. No. 2736, *p.* 411. The observations were made with the 4½ inch equatorial. The disappearance of the planet and Satellites I and II, and the reappearance of the planet and Satellites I, II, and III, were observed. This paper is reprinted with some typographical errors in the "Astronomical Register," for September, 1886.

OBSERVATIONS OF COMET I (FABRY), 1886.—*Ast. Nach., Band* CXV. No. 2760, *p.* 393. The observations were made with the 4½ inch equatorial on May 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 20, 21, 22, 23, 26, 30, 31, June 1, 5, 7, 1886, on the first four dates with the filar-micrometer, and on the remaining dates with the square bar-micrometer. The results are apparent right ascensions and north polar distances of the comet, with the corresponding parallax factors and the reductions of the star places. The mean places of the comparison stars, thirty-five in number, are also given based on all available authorities.

OBSERVATIONS OF PHENOMENA OF JUPITER'S SATELLITES IN 1886:—*R.A.S. Monthly Notices, Vol* XLVII. *p.* 30. The observations were made partly with the 4½ inch and partly with the 8 inch equatorial, and may be summed up as follows:—Eclipses:—Sat. I, nine reappearances; Sat. II, five reappearances; Sat. III, two disappearances and five reappearances; Sat. IV, one disappearance and one reappearance in the same eclipse. Transit-ingress, one observation of Satellites I, II, and III. Transit-egress, one observation of Satellite II, and one Occultation-disappearance of Satellites I, II, and III.

OBSERVATIONS OF COMET II (BARNARD), AND V (BROOKS I), 1886:—*Ast. Nach., Band* CXVI. No. 2768, *p.* 123. The observations were made with the square bar-micrometer on the 4½ inch equatorial. The former comet was observed on May 31, June 3, 10, 11, 13, 27, 29, and July 1, 1886, and the latter on July 3, 4, 11, 12, 21, 1886. The results are apparent right ascensions and north polar distances of the comet with the corresponding parallax factors and reductions of the star places. The mean places of the comparison stars, twenty-three in number, are also given from all available authorities.

OBSERVATIONS OF WINNECKE'S COMET AT ITS RETURN TO PERIHELION IN 1886:—*R.A.S. Monthly Notices, Vol.* XLVII. *p.* 293. These are apparent right ascensions and north polar distances deduced from ring and square bar-micrometer observations with the 4½ and 8 inch equatorials on August 25, 28, 29, September 1, 2, 5, 7, 8, 10, 11, 12, 15, 16, 17, 18, 20, 21, 22, 23, 24, 28, 30, October 1, 5, 6, 7, 11, 21, 23, 25, 27, 29, 1886, to which the usual parallax factors are added. The mean places of the comparison stars, sixty-two in number, are also given as derived from all available authorities, with the reductions to the apparent places.

THE GREAT SOUTHERN COMET OF JANUARY, 1887:—*Ast. Nach., Band* CXVI. No. 2780, *p.* 319. This is a re-print of the communication in the *Observatory*, Vol. X. p. 166.

OBSERVATIONS OF SATURN AND δ GEMINORUM:—*R.A.S Monthly Notices, Vol.* XLVII. *p.* 431. These consist of filar-micrometer comparisons on the 8 inch equatorial, with the resulting geocentric places of the planet.

OBSERVATIONS OF COMET VII (FINLAY), 1886:—*Ast. Nach., Band* CXVII. No. 2791, *p.* 109. The observations were made with the square bar-micrometer on the 8 inch equatorial, on

October 8, 22, 23, 24, 26, 28, November 7, 8, 9, 12, 15, 16, 22, 26, 27, 29, December 1, 15, 18, 19, 22, 27, 30, 1886. The results are apparent right ascensions and north polar distances of the comet with the corresponding parallax factors. The mean places of the comparison stars, 37 in number, are also given from all available authorities, together with the reductions to the apparent places for the dates of observation.

OCCULTATIONS OF STARS OBSERVED AT WINDSOR, N.S. WALES, OCT., 1885—DEC., 1886:—*Ast. Nach.*, *Band* CXVII. No. 2793, *p.* 143. These consist of the times of disappearance of fifty-three different stars at the moon's dark limb, the instruments employed being the 4½ and 8 inch equatorials.

PUBLICATION IN THE MEMOIRS OF THE ROYAL ASTRONOMICAL SOCIETY:—Observation of the Transit of Venus, December 8-9, 1874. Vol. XLVII., p. 89. All four contacts were well observed with the 4½ inch equatorial, and the results have been combined with all the other British observations in the determination of the Solar Parallax. See "R.A.S. Monthly Notices, Vol. XXXVIII., p. 429."

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Publication in the Catalogue of Natural and Industrial Products of N.S. Wales, for the Paris Exhibition of 1867, and in the Industrial Progress of N.S. Wales, 1870, pp. 55 and 617 respectively.

On the Progress and Present State of Astronomical Science in New South Wales.

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REPORT

OF

MR. TEBBUTT'S OBSERVATORY,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1888,

BY

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1889.

CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY.

For 1888.

AT the close of the year 1887, a pamphlet of 74 pages was published, entitled a "History and Description of Mr. Tebbutt's Observatory, Windsor, New South Wales." This little volume contains a detailed account of the Observatory buildings and of their instrumental equipment, and furnishes a list of all the scientific papers published by the proprietor, and of presents to the Observatory library, down to the close of August, 1887. The present Report will bring down the History of the Observatory to the close of the year 1888, under various heads, as follow :—

Buildings and Instruments.

These remain as they were at the close of August, 1887, so that a description of them will be unnecessary here. A general notion of the buildings can be formed from the frontispiece of the publication referred to. It will suffice to state that the principal instruments are a 3-inch transit instrument, by Cooke and Sons of York; a sidereal and a mean-time chronometer, by Parkinson and Frodsham and by Poole, respectively; an 8-inch equatorial, by Grubb of Dublin; a $4\frac{1}{2}$-inch equatorial, by Cooke and Sons; and a $3\frac{1}{4}$-inch refractor, by Jones.

Geographical Position of the Observatory.

The best local determination of the longitude is that published by the author in R. Ast. Society's Monthly Notices, Vol. XL., p. 440. The result is 10h. 3m. 21.81s. E. of Greenwich, and is derived from twenty-three occultation phases, namely, nineteen disappearances and four reappearances. The occulted stars are well known ones, and the moon's tabular places were corrected from meridian observations at Greenwich, Radcliffe, and Washington. With a view to obtain a fundamental meridian for the Australian Colonies from absolute methods, Dr. Auwers of Berlin, in 1884, discussed a series of seventy-six disappearances of stars at the moon's dark limb, observed at Windsor in the years 1873, 1874, 1875, and 1876, and arrived at 10h. 3m. 21.25s. E. as the longitude of Windsor, a result which differs only 0.56s. from that just mentioned. Combining this value with that derived for Melbourne from ten disappearances and two reappearances in the years 1874 and 1875, with moon-culmination results at Sydney and Melbourne, and approximate values of the telegraphic differences of longitude between Sydney and Melbourne and Sydney and Windsor, he derived 10h. 4m. 49.60s. E. as the longitude of Sydney. Subtracting 1m. 28.83s. from this result, he gets 10h. 3m. 20.77s. E. as the longitude of Windsor. In 1887, Professor Harkness of Washington, recognising the great importance of the result derived for Windsor from the occultations of 1873-76, suggested to me the desirability of determining with all possible accuracy the differences of longitude between the Windsor Observatory and the Government Observatories at Sydney and Melbourne. Immediately on the receipt of Professor Harkness' letter, I communicated with Mr. Lenehan, the Acting Government Astronomer at Sydney, and Mr. Ellery, the Government Astronomer at Melbourne, and the result was that exchanges of telegraphic signals were made with the most satisfactory results, as described in a paper read before the Royal Astronomical Society in April, 1888, and published in the Society's Notices, Vol. XLVIII., p. 313. The Windsor observations, in full detail, were

forwarded to Professor Harkness, together with the Sydney and Melbourne signals, clock-errors, and rates. He proposes to work out the Windsor chronometer errors and rates by the method of least squares, in order to get the best possible values from the observations. Meanwhile, adopting 1m. 29.39s. and 24m. 55.26s. as the differences of longitude between Sydney and Windsor and Sydney and Melbourne respectively (see the author's paper above referred to), and applying these amended differences according to the combination employed by Dr. Auwers, we get 10h. 4m. 49.90s. E. and 10h. 3m. 20.51s. E. as the longitudes of Sydney and Windsor from Greenwich. Considering the number of links in the whole chain of telegraphic connection with Greenwich, this result is probably as trustworthy as that derived from the late telegraphic connection with Singapore. The most reliable value of the latitude is $-33° 36' 30.8''$, which was derived from a series of prime vertical observations, in 1881, of well-determined stars close to the zenith with the 3-inch transit instrument. (See the author's paper in R.A.S. Monthly Notices, Vol. XLIV., p. 101.) Nothing further has been done in the way of investigating the latitude, if we except the circumstance that in 1887 the author made a trigonometrical connection between the Observatory transit-instrument and the north terminal of the Government base-line, about three miles nearly due west of the Observatory. This connection, which was established with an ordinary steel tape and a 5-inch theodolite reading to minutes of arc, gave $-33° 36' 30.5''$ as the latitude of the transit and equatorial piers, which differs only $0.3''$ from the value obtained directly from the prime vertical observations of 1881. The geographical latitude of the terminal as furnished by the head of the Trigonometrical Survey is $-33° 35' 58.07''$.

Meridian Work.

This has been done throughout with the 3-inch transit instrument in connection with sidereal chronometer (Parkinson and Frodsham) No. 1042. The transit system consists of five wires, designated A, B, C, D, and

E, in the order of transit above the pole when the clamp is east. The equatorial distances in sidereal time of the four outer wires from the middle wire were re-determined from all the transits of circumpolar stars observed in 1887, with the following results:—A + 19.492s. B + 9.782s. D − 10.001s. E − 19.656s., which have been employed throughout the reductions of 1888. The reduction for a complete observation of an equatorial star at the upper culmination, clamp east, has therefore been − 0.077s. The reduction for any other star is this quantity multiplied by the secant of the star's declination, and has been taken from a MS. table having for its argument the star's declination. For incomplete transits the reduction for an equatorial star is taken from a MS. table giving the algebraic means of the observed wires. The observations have all been made by the eye and ear method. The level and azimuth errors of the transit instrument, considering the foundation of the pier, which consists of clay and loam, have been pretty steady throughout the year. The level employed is a striding one of 1130 feet radius, each division being equal to 0.8″. The inclination was determined once at least on each evening of observation by four readings of each extremity of the bubble, the level being twice reversed during the operation. On some occasions, and always when the transit instrument has been reversed, two or more sets of readings have been taken. When the western pivot is the higher, the level error is regarded as positive. The collimation error was determined at intervals of a few days by comparing the middle wire in both positions of the axis of rotation with the corresponding wire of a two-inch transit instrument on a pier a little north of the transit-room. The middle wire of the collimator is slightly inclined for the purpose, and the comparison is always made near the horizontal wires. As there is no micrometer in connection with the transit system, the distance of the middle wire from that of the collimator is estimated for each position of the axis of rotation in terms of the diameter of the wire. Half the total displacement reduced to seconds of arc from the known diameter of the wire is

regarded as the collimation error. When the middle wire falls east of the collimation axis of the telescope with the clamp east, the collimation error is regarded as positive. On every occasion when the instrument has been reversed, star transits have been observed in both positions of the rotation axis, and by allowing for chronometer rate, it has been found that the estimations for collimation error are quite as reliable as the results which might be obtained by the application of the micrometer to so small an instrument. The collimation errors for dates between those on which the reversals were made are simply interpolated. The azimuth error has been determined at short intervals either from opposite culminations of β Hydri and β Chamæleontis, from contacts and bi-sections of σ Octantis at the middle wire and an approximate chronometer correction, or from transits of a star in pretty high south declination and one near the equator. The values for intermediate dates when no azimuth stars could be observed have been interpolated, and on these occasions stars as near the zenith as possible have been observed for time. Very carefully constructed MS. tables have been employed for the reductions for level, collimation, and azimuth. For all stars north of the zenith a table has been used whose arguments are each degree of declination from $-33°$ to $+56°$, and the values of the level, collimation, and azimuth errors for every second of arc from 1 to 15. The stars for time determinations, irrespective of the azimuth stars, have been taken from those with a declination less than 40° in the fundamental list on pages 320-367 of the Greenwich *Nautical Almanac*, with one occasionally from the moon-culminating list. It may here be added, that all time observations out of the meridian in connection with lunar occultations, phenomena of Jupiter's satellites, comets, &c., have been made with the sidereal chronometer (Parkinson and Frodsham), whose corrected indications are converted into local mean time by employing the sidereal time at Greenwich mean noon of the *Nautical Almanac*, corrected by the quantity $-$1m. 39.12s. These conversions have been carefully checked by the use of the mean time

of the preceding transit of the First Point of Aries, corrected by the quantity +1m. 38.84s. In the following table will be found a statement of the errors of the transit instrument and of the errors and rates of the sidereal chronometer (Parkinson and Frodsham) for the year 1888. It must be understood that the instrumental errors in brackets are simply interpolated. I believe it is proposed to add to the *Nautical Almanac* list of clock stars for 1891 a number of stars in high south declination. This addition will, I think, prove very acceptable to southern observers. As the *American Nautical Almanac* now contains the apparent places of a number of well-distributed stars in high south declination, it is proposed to employ the data thus afforded for the determinations of azimuth during the year 1889.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			"	"	"		H. M.	M. S.	S.	S.
Jan. 3	4	E.	+ 6.2	[+ 2.2]	— 4.70	μ Geminorum, Canopus	6 27	15 29.88		
,, 15	3	E.	+ 10.6	[+ 1.7]	[— 4.4]		7 4	16 33.53	0.221	0.23
,, 20	7	E.W.	+ 8.3	+ 1.5	— 4.30	γ Hydri, A Tauri	4 40	17 1.79	0.240	0.24
Feb. 19	7	W.E.	+ 9.0	+ 2.3	[— 5.2]	...	7 31	20 0.86	0.248	0.24
,, 20	8	E.	+ 7.5	[+ 2.3]	— 5.22	μ Geminorum, Canopus	6 51	20 6.41	0.238	0.23
,, 21	8	E.W.	+ 8.9	+ 2.3	— 4.19	ν Orionis, Melb. 301	6 33	20 11.59	0.219	0.23
,, 22	5	W.	+ 10.9	[+ 2.1]	— 9.08	μ Geminorum, Canopus	6 7	20 17.45	0.248	0.25
,, 25	3	W.	+ 11.1	[+ 1.7]	— 9.92	δ Geminorum, Melb. 345	8 18	20 36.34	0.255	0.25
,, 26	4	W.E.	+ 10.6	+ 1.5	— 6.62	Canopus, γ Geminorum	6 49	20 42.07	0.255	0.23
,, 27	4	E.	+ 10.1	[+ 1.8]	[— 6.8]	...	5 6	20 46.58	0.202	0.21
,, 28	3	E.	+ 10.7	[+ 2.0]	[— 7.1]	...	5 1	20 51.94	0.224	0 24
,, 29	5	E.W.	+ 10.0	+ 2.3	— 7.29	Canopus, γ Geminorum	6 42	20 58.44	0.253	0.24
March 2	5	W.	+ 10.8	[+ 1.9]	[— 5.6]	...	7 50	21 9.45	0.224	0.21
,, 3	4	W.	+ 9.6	[+ 1.7]	[— 4.8]	...	5 26	21 13.72	0.198	0.20
,, 4	5	W.E.	+ 9.3	+ 1.5	— 3.99	ε Leporis, Capella	5 46	21 18.77	0.208	0.21
,, 5	3	E.	+ 6.9	[+ 0.5]	[— 5.3]	...	5 46	21 23.90	0.214	0.22
,, 6	3	E.	+ 9.4	[— 0.5]	[— 6.6]	...	5 53	21 29.38	0.227	0.23
,, 7	5	E.W.	+ 9.4	— 1.5	— 7.94	μ Geminorum, Canopus	6 51	21 35.44	0.242	0.23
,, 8	4	W.	+ 8.3	[— 1.2]	— 7.52	μ Geminorum, Canopus	7 6	21 40.88	0.224	0.22
,, 9	6	W.E.	+ 8.9	— 0.8	— 6.26	μ Geminorum, Canopus	6 32	21 45.85	0.212	0.20
,, 10	6	E.	+ 8.5	[0.0]	[— 5.7]	...	8 0	21 50.65	0.189	0.21
,, 11	6	E.W.	+ 8.7	+ 0.8	— 5.22	μ Geminorum, Canopus	6 50	21 56.13	0.240	0.23
,, 12	4	W.	+ 8.8	[+ 0.5]	— 9.76	Canopus, γ Geminorum	6 54	22 1.34	0.217	0.23
,, 13	4	W.	+ 9.2	[+ 0.3]	— 4.71	Canopus, γ Geminorum	7 5	22 7.24	0.244	0.24
,, 14	6	W.E.	+ 9.0	0.0	— 7.20	μ Geminorum, Canopus	6 55	22 12.68	0.228	0.22
,, 15	3	E.	+ 8.0	[+ 0.3]	[— 7.3]	...	6 12	22 17.82	0.221	0.23

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			″	″	″		H. M.	M. S.	S.	S.
Mar. 16	2	E.	+ 10.1	[+ 0.6]	[— 7.3]	...	9 9	22 24.11	0.233	0.23
„ 17	4	E.	+ 8.5	[+ 0.9]	[— 7.4]	...	7 21	22 29.25	0.232	0.23
„ 18	4	E.	+ 9.6	[+ 1.2]	[— 7.4]	...	5 58	22 34.47	0.231	0.22
„ 19	9	E.W.	+ 7.8	+ 1.5	— 7.50	κ Cancri, ι Argûs	8 28	22 40.03	0.210	0.21
„ 20	5	W.	+ 8.9	[+ 1.0]	— 7.01	κ Cancri, ι Argûs	8 53	22 45.25	0.214	0.23
„ 21	4	W.	+ 9.0	[+ 0.5]	[— 6.7]	...	7 57	22 50.92	0.246	0.24
„ 22	9	W.E.	+ 9.2	0.0	— 6.33	κ Cancri, ι Argûs	8 11	22 56.51	0.231	0.23
„ 24	3	E.	+ 9.9	[+ 0.3]	— 5.16	Canopus, γ Geminorum	7 5	23 7.67	0.238	0.24
„ 26	4	E.	+ 9.8	[+ 0.6]	— 5.01	μ Geminorum, Canopus	6 22	23 18.95	0.239	0.23
„ 28	6	E.W.	+ 10.0	+ 0.8	— 4.39	μ Geminorum, Canopus	7 42	23 30.15	0.227	0.22
„ 29	3	W.	+ 9.9	[+ 0.6]	[— 4.0]	...	7 25	23 35.23	0.214	0.22
„ 31	4	W.	+ 10.7	[+ 0.3]	[— 3.3]	...	7 42	23 46.16	0.226	0.22
April 1	7	W.	+ 9.9	[+ 0.2]	— 2.92	Canopus, γ Geminorum	6 21	23 51.03	0.215	0.21
„ 2	7	W.E.	+ 8.8	0.0	— 3.34	μ Geminorum, Canopus	6 56	23 56.12	0.207	0.23
„ 2	3	E.	+ 8.9	[+ 0.3]	[— 3.7]	...	18 24	23 58.86	0.239	0.23
„ 5	5	E.	+ 9.6	[+ 1.7]	[— 5.7]	...	7 19	24 11.82	0.213	0.22
„ 6	7	E.W.	+ 9.5	+ 2.3	— 6.43	κ Cancri, ι Argûs	8 52	24 17.48	0.222	0.23
„ 9	3	W.	+ 10.8	[+ 2.0]	[— 5.3]	...	11 47	24 35.81	0.245	0.23
„ 12	3	W.	+ 9.2	[+ 1.7]	[— 4.2]	...	8 38	24 51.20	0.224	0.22
„ 13	2	W.	+ 9.8	[+ 1.6]	[— 3.8]	...	9 44	24 56.74	0.221	0.22
„ 14	6	W.E.	+ 8.4	+ 1.5	— 3.41	κ Cancri, ι Argûs	9 22	25 1.85	0.216	0.21
„ 15	5	E.	+ 8.6	[+ 1.8]	[— 3.9]	...	8 12	25 6.57	0.207	0.21
„ 16	6	E.	+ 8.5	[+ 2.0]	— 4.26	Canopus, γ Geminorum	8 41	25 11.77	0.212	0.22
„ 17	9	E.W.	+ 8.4	+ 2.3	— 5.01	μ Geminorum, Canopus	9 1	25 17.12	0.220	0.22
„ 18	4	W.	+ 8.5	[+ 2.1]	— 5.09	β Leonis, β Chamæleontis	10 53	25 22.97	0.226	0.22
„ 20	4	W.	+ 8.6	[+ 1.8]	[— 6.0]	...	8 47	25 33.13	0.221	0.21

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			″	″	″		H. M.	M. S.	S.	S.
April 21	3	W.	+ 9.5	[+ 1.7]	[− 6.5]	...	8 30	25 38.14	0.211	0.23
,, 22	8	W.E.	+ 8.9	+ 1.5	− 6.92	κ Cancri, ι Argûs	8 47	25 44.17	0.248	0.22
,, 22	1	E.	+ 8.2	[+ 1.6]	[− 6.8]	...	18 4	25 46.08	0.206	0.20
,, 23	2	E.	+ 8.2	[+ 1.9]	[− 6.5]	...	8 26	25 48.99	0.203	0.22
,, 24	2	E.	+ 8.5	[+ 2.3]	[− 6.0]	...	8 7	25 55.11	0.258	0.24
,, 25	2	E.	+ 9.3	[+ 2.6]	[− 5.6]	...	8 24	26 0.51	0.222	0.21
,, 26	6	E.W.	+ 7.6	+ 3.0	− 5.16	κ Cancri, ι Argûs	8 28	26 5.48	0.207	0.21
,, 27	2	W.	+ 7.6	[+ 2.5]	[− 5.0]	...	8 33	26 10.55	0.211	0.21
,, 28	2	W.	+ 9.2	[+ 2.0]	[− 4.8]	...	8 33	26 15.41	0.203	0.21
,, 29	2	W.	+ 8.8	[+ 1.5]	[− 4.7]	...	7 39	26 20.37	0.215	0.22
,, 30	2	W.	+ 8.3	[+ 1.0]	[− 4.5]	...	7 14	26 25.56	0.220	0.23
May 1	2	W.	+ 8.2	[+ 0.5]	− 4.38	κ Cancri, ι Argûs	9 38	26 31.68	0.232	0.23
,, 2	6	W.E.	+ 8.2	0.0	− 6.53	κ Cancri, ι Argûs	8 20	26 36.87	0.233	0.23
,, 4	3	E.	+ 9.3	[+ 0.3]	[− 5.0]	...	7 27	26 47.77	0.231	0.24
,, 5	1	E.	+ 8.9	[+ 0.5]	[− 4.3]	...	7 7	26 53.55	0.244	0.23
,, 6	3	E.	+ 7.9	[+ 0.7]	[− 3.7]	...	10 39	26 59.44	0.214	0.18
,, 7	3	E.	+ 6.6	[+ 0.8]	[− 2.9]	...	11 37	27 3.31	0.155	0.16
,, 8	6	E.W.	+ 7.2	+ 1.0	− 2.16	ι Argûs, ο Leonis	9 7	27 6.75	0.160	0.17
,, 14	5	W.E.	+ 9.4	+ 1.5	− 4.81	ι Argûs, ο Leonis	9 14	27 35.47	0.199	0.20
,, 15	3	E.	+ 8.7	[+ 1.6]	[− 5.2]	...	11 42	27 40.80	0.201	0.19
,, 16	2	E.	+ 8.3	[+ 1.8]	[− 5.6]	...	10 52	27 45.14	0.187	0.18
,, 17	2	E.	+ 8.1	[+ 1.9]	[− 6.0]	...	14 44	27 50.08	0.177	0.21
,, 18	5	E.W.	+ 8.4	+ 2.0	− 6.43	κ Cancri, ι Argûs	10 41	27 54.98	0.246	0.21
,, 19	3	W.	+ 9.4	[+ 2.3]	[− 6.1]	...	10 40	27 59.18	0.175	0.18
,, 20	5	W.	+ 8.0	[+ 2.7]	[− 5.8]	...	13 15	28 4.16	0.187	0.17
,, 21	9	W.E.	+ 8.0	+ 3.0	− 5.44	β Chamæleontis, β Hydri	10 49	28 7.71	0.165	0.17

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			"	"	"		H. M.	M. S.	S.	S.
May 22	2	E.	+ 7.3	[+ 2.8]	[— 4.7]	...	11 32	28 11.93	0.171	0.17
„ 23	3	E.	+ 7.5	[+ 2.7]	[— 3.9]	...	11 34	28 16.71	0.174	0.18
„ 24	3	E.	+ 7.2	[+ 2.5]	[— 3.2]	...	13 25	28 20.85	0.183	0.18
„ 25	7	E.W.	+ 7.4	+ 2.3	— 2.40	β Chamæleontis, β Hydri	12 49	28 24.79	0.168	0.17
„ 26	2	W.	+ 7.7	[+ 2.3]	[— 2.6]	...	12 38	28 28.67	0.163	...
June 8	2	W.	+ 9.4	[+ 1.6]	[— 4.7]	...	14 3	0 8.52	...	...
„ 10	8	W.E.	+ 8.1	+ 1.5	— 5.00	β Chamæleontis, β Hydri	11 10	0 18.61	0.224	0.23
„ 11	4	E.	+ 9.2	[+ 1.5]	[— 4.4]	...	12 13	0 24.39	0.231	0.23
„ 12	5	E.	+ 9.5	[+ 1.5]	[— 3.9]	...	12 18	0 29.74	0.222	0.21
„ 13	4	E.	+ 8.4	[+ 1.5]	— 3.32	η Bootis, β Centauri	12 58	0 34.61	0.197	0.19
„ 14	7	E.W.	+ 8.6	+ 1.5	— 6.30	β Chamæleontis, β Hydri	11 41	0 38.89	0.188	0.20
„ 15	2	W.	+ 9.0	[+ 1.7]	[— 5.4]	...	12 27	0 44.07	0.209	0.20
„ 16	4	W.	+ 9.0	[+ 1.9]	[— 4.5]	...	12 24	0 48.73	0.195	0.19
„ 17	3	W.	+ 8.1	[+ 2.1]	[— 3.7]	...	12 5	0 53.30	0.193	0.21
„ 18	7	W.E.	+ 7.1	+ 2.3	— 2.78	β Chamæleontis, β Hydri	12 23	0 58.83	0.228	0.23
„ 19	3	E.	+ 7.4	[+ 2.4]	[— 2.5]	...	13 19	1 4.63	0.233	0.23
„ 21	3	E.	+ 7.4	[+ 2.7]	[— 1.9]	...	13 31	1 14.94	0.214	0.20
„ 22	3	E.	+ 7.4	[+ 2.8]	— 1.64	β Chamæleontis, β Hydri	12 29	1 19.45	0.196	0.18
„ 23	3	E.	+ 7.1	[+ 2.9]	[— 1.5]	...	12 31	1 23.46	0.167	0.17
„ 24	7	E.W.	+ 6.7	+ 3.0	— 1.45	β Chamæleontis, β Hydri	13 1	1 27.80	0.177	0.17
„ 26	4	W.	+ 6.9	[+ 2.7]	[— 3.0]	...	14 16	1 35.18	0.150	0.15
„ 28	4	W.	+ 6.9	[+ 2.5]	— 4.45	β Chamæleontis, β Hydri	12 44	1 41.85	0.144	0.17
July 3	3	W.	+ 9.4	[+ 1.9]	[— 4.2]	...	13 11	2 8.74	0.223	0.19
„ 4	2	W.	+ 8.2	[+ 1.8]	— 4.14	β Chamæleontis, β Hydri	12 16	2 13.06	0.187	0.19
„ 5	3	W.	+ 8.2	[+ 1.6]	— 1.70	β Chamæleontis, β Hydri	12 37	2 17.69	0.190	0.18
„ 6	4	W.E.	+ 9.2	+ 1.5	[— 1.8]	...	12 21	2 21.88	0.177	0.18

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			″	″	″		H. M.	M. S.	S.	S.
July 8	3	E.	+ 8.9	[+ 1.5]	[— 2.0]	...	12 59	2 30.78	0.183	0.21
„ 9	3	E.	+ 9.6	[+ 1.5]	[— 2.1]	...	14 12	2 36.44	0.225	0.23
„ 10	2	E.	+ 9.4	[+ 1.5]	[— 2.2]	...	12 24	2 41.79	0.241	0.23
„ 11	3	E.	+ 8.7	[+ 1.5]	— 2.25	η Virginis, α Crucis	12 25	2 46.98	0.216	0.21
„ 12	6	E.W.	+ 9.5	+ 1.5	— 1.88	η Virginis, α Crucis	18 3	2 51.94	0.201	0.19
„ 14	3	W.	+ 9.0	[+ 0.5]	[— 3.6]	...	12 41	2 59.86	0.166	0.19
„ 15	3	W.	+ 7.5	[0.0]	[— 4.5]	...	12 33	3 4.30	0.186	0.18
„ 16	3	W.	+ 9.6	[— 0.5]	[— 5.4]	...	13 3	3 8.61	0.175	0.17
„ 18	6	W.E.	+ 6.6	— 1.5	— 7.14	α Tri. Australis, κ Ophiuchi	13 49	3 16.50	0.162	0.18
„ 19	2	E.	+ 7.7	[— 0.7]	[— 6.7]	...	13 15	3 20.79	0.183	0.19
„ 21	8	E.	+ 7.9	[+ 0.8]	— 5.77	α Tri. Australis, κ Ophiuchi	15 35	3 31.10	0.205	0.22
„ 22	5	E.	+ 8.3	[+ 1.5]	[— 5.3]	...	13 43	3 36.18	0.229	0.22
„ 23	6	E.W.	+ 9.3	+ 2.3	— 4.91	α Tri. Australis, κ Ophiuchi	14 55	3 41.72	0.220	0.22
„ 25	3	W.	+ 8.8	[+ 2.4]	[— 5.4]	...	13 19	3 51.89	0.219	0.19
„ 26	2	W.	+ 8.7	[+ 2.5]	[— 5.6]	...	13 28	3 56.16	0.177	0.18
„ 31	2	W.	+ 9.6	[+ 2.9]	[— 6.8]	...	17 22	4 20.21	0.194	0.22
Aug. 1	3	W.	+ 9.6	[+ 2.9]	[— 7.1]	...	17 8	4 25.59	0.226	0.21
„ 2	6	W.E.	+ 9.8	+ 3.0	— 7.32	*f* Bootis, α[2] Centauri	15 36	4 30.00	0.196	0.20
„ 3	2	E.	+ 9.6	[+ 3.0]	[— 5.9]	...	16 8	4 35.04	0.206	0.20
„ 6	4	E.	+ 9.0	[+ 3.0]	— 1.70	σ Octantis	16 41	4 48.77	0.189	0.18
„ 7	6	E.W.	+ 9.6	+ 3.0	— 4.00	α Tri. Australis, κ Ophiuchi	17 14	4 53.26	0.183	0.18
„ 8	3	W.	+ 9.9	[+ 2.9]	— 6.43	σ Octantis	16 21	4 57.18	0.170	0.17
„ 9	4	W.	+ 9.8	[+ 2.8]	[— 6.4]	...	15 36	5 1.37	0.180	0.18
„ 10	2	W.	+ 9.2	[+ 2.6]	[— 6.3]	...	16 18	5 5.58	0.170	0.17
„ 13	6	W.E.	+ 10.3	+ 2.3	— 6.16	α Tri. Australis, κ Ophiuchi	17 12	5 19.01	0.184	0.18
„ 14	6	E.	+ 8.7	[+ 2.1]	[— 6.3]	...	18 42	5 23.58	0.179	0.18

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			″	″	″		H. M.	M. S.	S.	S.
Aug. 15	2	E.	+ 9.9	[+ 2.0]	[− 6.4]	...	17 44	5 27.87	0.186	0.19
„ 18	6	E.W.	+ 9.9	+ 1.5	− 6.62	α Tri. Australis, κ Ophiuchi	16 47	5 41.69	0.195	0.21
„ 20	9	W.E.	+ 10.2	+ 1.5	− 5.29	σ Octantis	18 22	5 52.50	0.218	0.21
„ 21	6	E.	+ 11.3	[+ 1.4]	− 4.78	α Tri. Australis, κ Ophiuchi	17 54	5 57.10	0.199	0.20
„ 22	3	E.	+ 9.6	[+ 1.4]	[− 5.2]	...	16 41	6 1.62	0.198	0.20
„ 23	2	E.	+ 10.8	[+ 1.3]	[− 5.6]	...	20 15	6 7.40	0.210	0.20
„ 24	3	E.	+ 10.7	[+ 1.2]	[− 6.0]	...	17 16	6 11.51	0.196	0.20
„ 27	4	E.W.	+ 10.7	+ 1.0	− 7.27	α Tri. Australis, κ Ophiuchi	16 56	6 26.56	0.210	0.21
„ 30	2	W.	+ 11.2	[+ 0.9]	[− 8.4]	...	16 38	6 42.09	0.217	0.21
Sept 11	4	W.	+ 12.6	[+ 0.5]	− 13.05	α Pavonis, ε Delphini	20 25	7 42.23	0.206	0.18
„ 12	5	W.E.	+ 11.5	+ 0.5	− 9.68	θ Aquilæ, α Pavonis	19 43	7 46.26	0.173	0.17
„ 13	2	E.	+ 11.5	[+ 0.4]	− 8.27	σ Octantis	17 26	7 50.09	0.176	0.17
„ 14	8	E.	+ 12.8	[+ 0.3]	− 9.11	σ Octantis	20 4	7 54.45	0.164	0.18
„ 15	3	E.	+ 12.6	[+ 0.2]	[− 7.3]	...	19 29	7 58.91	0.190	0.21
„ 16	6	E.	+ 13.0	[+ 0.1]	− 5.55	θ Aquilæ, α Pavonis	21 5	8 4.57	0.221	0.22
„ 17	5	E.W.	{+ 13.1 + 19.2}	+ 0.0	− 6.32	σ Octantis	19 14	8 9.58	0.226	0.23
„ 18	3	W.	+ 2.2	[+ 0.5]	− 0.28	σ Octantis	19 23	8 15.46	0.244	0.24
„ 23	5	W.E.	+ 2.4	+ 3.0	− 5.50	σ Octantis	19 24	8 42.99	0.229	0.23
„ 27	3	E.	+ 1.6	[+ 3.8]	[− 5.5]	...	19 38	9 5.71	0.236	0.23
„ 29	2	E.	+ 2.5	[+ 4.3]	[− 5.5]	...	19 45	9 16.48	0.224	0.23
„ 30	7	E.W.	+ 3.0	+ 4.5	− 5.55	ε Aquarii, α Octantis	19 45	9 22.18	0.238	0.24
Oct. 2	4	W.	+ 3.0	[+ 4.0]	− 8.01	α Pavonis, β Aquarii	21 4	9 33.83	0.236	0.24
„ 3	3	W.	+ 1.3	[+ 3.7]	− 7.91	θ Aquilæ, α Pavonis	20 23	9 39.48	0.242	0.24
„ 11	7	W.E.	+ 2.5	+ 1.5	− 4.65	α Aquarii, ν Octantis	22 16	10 23.21	0.226	0.22
„ 12	5	E.	+ 2.5	[+ 2.1]	− 4.45	θ Aquilæ, α Pavonis	20 48	10 28.13	0.218	0.22

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1888.			"	"	"		H. M.	M. S.	S.	S.
Oct. 13	4	E.	+ 3.4	[+ 2.7]	[— 4.6]	...	20 58	10 33.60	0.226	0.28
„ 16	7	E.W.	+ 4.3	+ 4.5	— 5.08	θ Aquilæ, α Pavonis	21 30	10 51.51	0.247	0.24
„ 18	2	W.	+ 4.3	[+ 3.5]	[— 5.1]	...	21 15	11 2.78	0.236	0.23
„ 22	6	W.E.	+ 2.5	+ 1.5	— 5.30	B.A.C. 7020, ε Pegasi	21 54	11 24.54	0.225	0.23
Nov. 4	2	E.	+ 1.5	[+ 2.9]	[— 5.4]	...	23 2	12 46.95	0.263	0.26
„ 5	5	E.W.	+ 1.3	+ 3.0	— 5.45	ξ²Ceti, μ Hydri	2 29	12 54.21	0.265	0.26
„ 8	4	W.	— 2.4	[+ 3.0]	[— 5.3]	...	22 54	13 10.93	0.244	0.24
„ 10	5	W.	— 3.5	[+ 3.0]	[— 5.2]	...	0 11	13 22.94	0.244	0.25
„ 11	6	W.E.	— 3.9	+ 3.0	— 5.18	τ Octantis, κ Piscium	23 21	13 28.71	0.249	0.26
„ 12	4	E.	— 4.1	[+ 3.0]	[— 4.8]	...	23 11	13 35.06	0.267	0.28
„ 13	3	E.	— 4.7	[+ 3.0]	[— 4.5]	...	23 14	13 42.13	0.294	0.29
„ 14	3	E.	— 5.4	[+ 3.0]	[— 4.2]	...	23 50	13 49.17	0.286	0.29
„ 15	6	E.W.	— 5.2	+ 3.0	— 3.82	β Chamæleontis, β Hydri	23 32	13 56.14	0.294	0.28
„ 17	3	W.	— 7.8	[+ 2.5]	[— 4.6]	...	23 7	14 8.64	0.263	0.27
„ 19	2	W.	— 9.2	[+ 2.0]	[— 5.4]	...	4 41	14 23.55	0.278	0.26
„ 20	2	W.	— 10.3	[+ 1.8]	[— 5.7]	...	23 10	14 28.27	0.255	0.24
„ 21	6	W.E.	— 9.7	+ 1.5	— 6.12	β Chamæleontis, β Hydri	23 27	14 33.92	0.233	0.23
„ 22	3	E.	— 8.7	[+ 1.6]	[— 6.0]	...	23 30	14 39.58	0.235	0.24
„ 26	3	E.	— 10.9	[+ 2.1]	[— 5.4]	...	23 59	15 4.05	0.254	0.25
„ 27	3	E.	— 8.6	[+ 2.3]	[— 5.3]	...	23 59	15 10.00	0.248	0.25
Dec. 1	2	E.	— 9.5	[+ 2.9]	— 4.72	β Chamæleontis, β Hydri	0 32	15 34.53	0.254	0.25
„ 2	4	E.W.	— 9.6	+ 3.0	— 6.44	α Andromedæ, β Hydri	0 56	15 40.51	0.245	0.24
„ 3	3	W.	— 10.0	[+ 2.9]	[— 6.3]	...	0 19	15 46.06	0.237	0.23
„ 4	2	W.	— 8.1	[+ 2.8]	[— 6.2]	...	0 24	15 51.63	0.231	0.24
„ 5	2	W.	— 7.2	[+ 2.6]	[— 6.0]	...	1 6	15 57.66	0.244	0.27
„ 6	2	W.	— 4.5	[+ 2.5]	[— 5.9]	...	0 57	16 4.63	0.292	0.29

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rates at Mean of Group.
1888.			"	"	"		H. M.	M. S.	S.	S.
Dec. 8	3	W.	— 5.6	[+ 2.3]	[— 5.6]	...	2 25	16 19.07	0.292	0.29
„ 10	3	W.	— 5.1	[+ 2.0]	[— 5.3]	...	1 3	16 32.45	0.287	0.26
„ 11	4	W.	— 6.4	[+ 1.9]	[— 5.2]	...	5 2	16 39.30	0.245	0.24
„ 14	1	W.	— 5.0	[+ 1.5]	[— 4.8]	...	0 55	16 55.45	0.238	0.24
„ 18	2	W.	— 4.5	[+ 1.0]	[— 4.2]	...	5 8	17 19.44	0.239	0.24
„ 19	1	W.	— 5.0	[+ 0.9]	[— 4.1]	...	4 10	17 25.12	0.247	0.25
„ 20	3	W E.	— 3.8	+ 0.8	— 3.96	β Hydri, β Ceti	2 18	17 30.54	0.245	0.23
„ 21	3	E.	— 3.9	[+ 1.5]	— 4.28	η Piscium, Achernar	1 45	17 35.73	0.221	0.23
„ 22	3	E.	— 4.0	[+ 2.3]	— 6.13	η Piscium, Achernar	1 34	17 41.28	0.233	0.25
„ 23	3	E.	— 4.5	[+ 3.0]	— 4.38	η Piscium, Achernar	1 25	17 47.79	0.273	0.26
„ 24	3	E.	— 3.8	[+ 3.8]	[— 3.4]	...	5 8	17 54.44	0.240	0.24
„ 25	5	E.W.	— 3.4	+ 4.5	— 2.48	Achernar, o Piscium	2 19	17 59.42	0.235	0.23
„ 26	3	W.	— 2.8	[+ 4.2]	[— 2.9]	...	2 30	18 5.08	0.234	0.24
1889.										
Jan. 1	4	W.E.	— 2.1	+ 2.3	— 5.49	η Tauri, γ Hydri	4 21	18 41.18	0.248	...

NOTE.—The chronometer error was diminished on June 8 by allowing the chronometer to run down. The difference in the level errors for clamp E. and W. on September 17 was due to a particle of dirt falling into the west segmental bearing in the act of reversing; subsequently to the observations it was discovered and removed. The eastern pivot was raised a little on September 18.

Extra-Meridian Work.

This work is of a varied character, and may be classed under different heads, as follows:—

Occultations of Stars by the Moon.—The occultations of fifty-three stars have been observed, comprising fifty-one disappearances at the dark and two at the bright limb, and three reappearances at the dark limb. Of the occulted stars, forty have been identified and thirteen have had their places approximately determined. The results have been forwarded to the *Astronomische Nachrichten*. The number of occultation phases observed here during the period 1864-1888 is 372, namely, 361 disappearances and 11 reappearances.

Phenomena of Jupiter's Satellites.—These have been observed chiefly with the 8-inch equatorial, and are classified thus:—Transit-ingress, I.7, II.5, III.1; Transit-egress, I.7, II.6, III.3. Occultation-disappearance, I.7, II.4; Occultation-reappearance, I.2, II.3, III.1. Eclipse-disappearance, I.5, II.3, III.5; Eclipse-reappearance, I.7, II.3, III.6. A complete observation of both phases of the eclipse of Satellite II. was obtained on August 6. All these results have been sent to the Royal Astronomical Society.

Occultations of Planets by the Moon.—The occultation of Venus in both phases was observed on March 9, and the disappearance of Saturn on June 13. The results have already been published in the Monthly Notices of the Royal Astronomical Society.

Occultation of 47 Libræ by Jupiter on June 10.—Both phases of this phenomenon were observed with the 8-inch equatorial, and a considerable number of filar-micrometer comparisons of the planet and star were made both before and after the occultation. The results are already published.

The Conjunction of Jupiter and β'Scorpii.—Two hundred and thirty comparisons of the planet and star were made with the 8-inch equatorial and Grubb filar-micrometer on twelve nights in May. The steadiness and definition were exceedingly satisfactory throughout the series. The results have been published and com-

pared with the tabular places of the *Nautical Almanac*. The deduced corrections to the *Nautical Almanac* declinations are pretty consistent throughout the series, but those for the right ascensions indicate a progressive change, which raises a suspicion as to the exact perpendicularity of the transit thread to the declination thread employed in orienting the micrometer. An investigation had previously been made, but it did not exhibit any decided error in the perpendicularity of the threads. Another very careful examination has recently been made, with the result that the inclination of the transit thread to the true meridian when the micrometer is oriented by means of the adopted fixed declination thread A is N. 0° 7′ E. The moveable declination thread, which is never employed for orientation, is sensibly out of parallel with the adopted fixed declination thread, but bisections with this thread are always made close to the position or transit thread.

THE MINOR PLANET PALLAS.—In consequence of the low altitude of the planet at Greenwich, Königsberg, Hamburg, and other places where the minor planets are systematically observed, a set of comparisons of this planet were obtained near its opposition, in November and December last, with the 8-inch equatorial and the Grubb filar-micrometer. The planet was observed on seventeen different nights, when 154 comparisons were obtained with the filar and ten with the square bar-micrometer. Excellent authorities are available for the places of the comparison stars, so that the deduced positions of the planet will doubtless compare favourably with places determined on the meridian. The reductions are considerably advanced.

COMETS.—Three comets were observed during the year. Comet *A* (Sawerthal), 1888, was observed on the mornings of February 28, 29, March 3, 4, 5, 7, 8, 9, 10, 11, 12, 15, 16, 18, 19, 20, 22, 26, 29, 30, April 1, 2, 3. The observations comprise 215 measures, twelve of which were made with the Cooke filar-micrometer on the 4½-inch equatorial, and all the rest with the Grubb filar-micrometer on the 8-inch equatorial. Thirty-six comparison stars were employed, and the results, with

the usual parallax factors, have been published. The earliest Windsor position of the comet, resting on seventeen excellent comparisons with well-determined stars, was selected by Herr Berberich of the Recheninstitut, Berlin, in conjunction with later European positions, for a determination of the elliptic elements. The comet cannot be identified with any known comet, and the period of revolution derived from the preliminary discussion is about 2370 years. Copies of Drs. Backlund and Seraphimoff's ephemeris of Encke's comet were received from St. Petersburg on June 29 and July 5. A search for the comet was made in the evening twilight on July 6, but without success. On the following evening pressing engagements prevented a search, but on the evening of the 8th the comet was found with the 4½-inch equatorial almost exactly in the position assigned to it in the ephemeris. It presented the appearance of a bright, round, nebulous star, uniformly condensed, and about 1′ in diameter. The comet rapidly became fainter and difficult of observation. Sixty-three square bar comparisons were obtained on July 8, 10, 11, 15, 16, 18, 25, 26, 31, and August 1, those from July 8 to 18 with the 4½-inch, and the subsequent observations with the 8-inch equatorial. The results, with the adopted places of the fifteen comparison stars, and the usual parallax-factors, have already appeared in the *Astronomische Nachrichten*. Barnard's comet of September 2, 1888, was observed with the square bar-micrometer on the 8-inch equatorial on November 5, 10, 12, 13, 21, 22, 26, December 1, 2, 3, 4, 5, 23, 24, 25, 26, 1888; also on January 2, 4, 5, 6 of the present year. The number of comparison stars is 21, and that of the comparisons 187. The resulting positions with the parallax-factors have been forwarded to the journal just mentioned, Faye's comet was glimpsed with the 8-inch telescope on December 3, near the position assigned to it by an extension of Dr. E. Lamp's ephemeris in No. 2861 of the *Astronomische Nachrichten*, but it was altogether too faint to be observed with the micrometer.

Double Stars.—The following interesting southern double stars have been measured with the 8-inch equa-

torial, both in position-angle and distance, during the past year :— *p* Eridani, *V* Puppis, Lacaille 2640, γ Piscis Volantis, γ Argûs, *h* 4432, *h* 4507, α Crucis, δ Corvi, γ Centauri, γ Virginis, Sydney new double stars Nos. 207 and 213, Lac 5632, Brisbane 4629-30, *h* 4634, *h* 4630, α Centauri, π Lupi, Sydney new double stars Nos. 267, 282, and 287, *h* 2061, and γ Coronæ Australis. The reductions are completed, and the results, with others in previous years, will shortly be published.

VARIABLE STARS.—Comparisons have been made, both of η Argûs and *R* Carinœ, with the neighbouring stars by means of the $3\frac{1}{4}$-inch refractor. They are, however, not so numerous as I could wish, in consequence of the multiplicity of my engagements. I have already announced in the *Astronomische Nachrichten* and the *Observatory* that a marked increase has taken place in the lustre of the former of these two remarkable stars.

SUNDRY OBSERVATIONS.—Under this head are comprised all the observations made during the year for the determination of the instrumental constants.

Meteorological Observations.

The usual 9h. a.m. observations have been kept up with great regularity during the year. They comprise observations of the barometer, maximum and minimum temperature of the air and of evaporation, maximum solar radiation, and minimum radiation on the grass, rainfall and evaporation, direction of the wind, and cloud extent, as in former years. The reduction of the observations for 1886, 1887, and 1888 are nearly completed, and the results, with those of 1889, will be published in 1890. Since 1862, the rainfall results have been forwarded annually to the Government Astronomer for incorporation with similar results from the Government Meteorological Stations.

Publications.

Since the appearance of the *History and Description of the Observatory* at the close of 1887 no publication has been issued directly from the Observatory. The following, however, is a list of the papers contributed by

the author to scientific societies and journals, and is intended to be a continuation of that published in the *History and Description of the Observatory.*

NOTE ON THE TAIL OF THE COMET 1865, I.:—*Ast. Nach., Band* CXVII., *No.* 2808, *p.* 385.—This is an explanation of the author's statements with reference to the apparent length of the tail, and also of the apparent inconsistency between his statements and those of Messrs. Moesta and Ellery respecting its curvature.

LALANDE 26481:—*Observatory,* Vol. X. *p.* 360.—This star is shown to have a considerable proper motion in right ascension and declination.

OΣ 256;—*Observatory,* Vol. X. *p.* 391:—Attention is here drawn to the phenomena attending the disappearance of this double star at the moon's dark limb on August 22, 1887, which tend to confirm the view that one or both of the components are variable.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES IN 1887:—*Royal Ast. Society's Monthly Notices, Vol.* XLVIII. *p.* 129.—These comprise a long series of observations with the 4½-inch and 8-inch equatorials.

OBSERVATIONS OF γ CORONÆ AUSTRALIS:—*Observatory, Vol.* XI. *p.* 133.—These comprise measures in position-angle and distance of the components in 1887 with the 8-inch equatorial.

OBSERVATIONS OF COMET A (SAWERTHAL), 1888:—*R.A.S. Monthly Notices, Vol.* XLVIII. *p.* 312.—This paper contains the results of filar-micrometer observations with the 8-inch equatorial on February 27, 28, March 2, 3, 4, 1888.

ON THE DIFFERENCE OF LONGITUDE BETWEEN MR. TEBBUTT'S OBSERVATORY, WINDSOR, N.S. WALES, AND THE GOVERNMENT OBSERVATORIES AT SYDNEY AND MELBOURNE:—*R.A.S. Monthly Notices, Vol.* XLVIII. *p.* 313.—This is an abstract of the results from exchanges of telegraphic signals with Sydney on May 28, 29, 30, 1885, June 8, July 7, 1887, and with Melbourne on June 13, 15, 23, August 15, 1887, and from transportations of a mean-time chronometer from Windsor to Sydney and back on May 13, 20, June 3, July 8, 20,

November 24, December 14, 1887. The resulting differences are:—

	m.	s.
Sydney—Windsor, from telegraphic signals	1	29.39
Windsor—Melbourne, from telegraphic signals	23	25.87
Sydney—Windsor, from transportations of the chronometer..	1	29.49

It also contains the result of a trigonometrical connection between the observatory transit pier and the north terminal of the Government base line near Richmond. This connection gives the difference Sydney—Windsor as 1m. 29.77s., and the geographical latitude of the pier as $-33^\circ\ 36'\ 30.5''$, the seconds being $30.8''$, as derived directly from prime-vertical observations in 1881.

OCCULTATIONS OF STARS AT WINDSOR IN 1887:—*Ast. Nach., Band* CXIX. *No.* 2837, *p.* 77.—This paper contains the times of the disappearances of twenty-three stars at the moon's dark limb, observed with the $4\frac{1}{2}$ and 8-inch equatorials.

OBSERVATIONS OF COMET A (SAWERTHAL), 1888:—*Ast. Nach., Band* CXIX. *No.* 2835, *p.* 41, *No.* 2838, *p.* 89, *and No.* 2843, *p.* 169, *and R.A.S. Monthly Notices, Vol.* XLVIII. *p.* 376.—See Report, p. 18.

OBSERVATION OF THE OCCULTATION OF VENUS BY THE MOON, 1888, MARCH 9:—*R.A.S. Monthly Notices, Vol.* XLVIII. *p.* 340.—See Report, p. 17.

OBSERVATIONS OF JUNO AND VESTA AT THE OPPOSITIONS OF 1887:—*Ast. Nach., Band* CXIX. *No.* 2842, *p.* 157.—This paper contains the results of filar-micrometer comparisons with the 8-inch equatorial of Juno on October 14, 15, 16, 1887, and Vesta on March 25, April 2, 9, 10, 19, 21, 27, 28, May 1, 1887. The geocentric apparent places are given, with the adopted mean places of the comparison stars and the reductions to the apparent places.

η ARGUS AND W.B. XIII. 595:—*Observatory, Vol.* XI., *p.* 299.—This communication notifies an increase of half a magnitude in the light of η Argus between April, 1887, and May, 1888, and an error in Bessel's place of the latter star.

INCREASE IN THE LIGHT OF η ARGUS:—*Ast. Nach., Band* CXIX. *No.* 2849, *p.* 269.—This communication

conveys the same information respecting this star as that contained in the paper last cited.

DISCOVERY OF ENCKE'S COMET:—*Ast. Nach., Band* CXIX. *No.* 2854, *p.* 349, *and Observatory, Vol.* XI., *p.* 338.—This is a notification of the comet's discovery on July 8, 1888, with its approximate position. See Report.

OBSERVATION OF THE OCCULTATION OF LALANDE 28923 BY JUPITER IN 1888, JUNE 10:—*Ast. Nach., Band* CXIX. *No.* 2856, *p.* 377.—See Report. The star is identical with 47 Libræ.

OBSERVATION OF THE OCCULTATION OF SATURN BY THE MOON, 1888, JUNE 13:—*R.A.S. Monthly Notices, Vol.* XLVIII., *p.* 396.—The disappearances only of Saturn and Titan were observed with the $4\frac{1}{2}$-inch equatorial.

RESULTS OF FILAR-MICROMETER COMPARISONS OF JUPITER AND β' SCORPII IN MAY, 1888:—*R.A.S. Monthly Notices, Vol.* XLIX., *p.* 40.—See Report.

OBSERVATIONS OF ENCKE'S COMET:—*Ast. Nach., Band* CXX. *No.* 2870, *p.* 219.—These were made in July and August, 1888. See Report.

COMET NOMENCLATURE:—*Observatory, Vol.* XI., *p.* 436.

RESULTS OF OBSERVATIONS OF COMETS VI. (WINNECKE) AND VII. (FINLAY), 1886, AT WINDSOR, N.S. WALES:—*Journal and Proceedings of the Royal Society of N.S. Wales, Vol.* XXI., *p.* 159.

RESULTS OF OBSERVATIONS OF COMETS I. (SAWERTHAL) AND II. (ENCKE), 1888, AT WINDSOR, N.S. WALES:—*Journal and Proceedings of the Royal Society of N.S. Wales, Vol.* XXII., *p.* 284.

The Library.

The library has been further enriched by the contributions of scientific institutions and friends in various countries. The *History and Description of the Observatory* contains an acknowledgment of all the presents received, from the establishment of the Observatory down to September 1, 1887. In a list at the close of this report will be found an acknowledgment of all presents received from that date to the close of 1888. For these expressions of sympathy with his work the author desires here to offer his warmest thanks.

Personal Establishment.

From the foundation of the Observatory to the present time the astronomical observations have been made solely by the author himself. The same may be said of nearly the whole of the meteorological observations. He has also to execute the greater and more difficult part of the reductions. The occasional services of an ordinary computer are required, but it has usually been found extremely difficult to get such assistance on the spot. This difficulty in getting the occasional assistance of a competent person in ordinary arithmetical calculation is remarkable, considering the circumstance that the town has for a long time been well supplied with educational facilities. During the Christmas vacation considerable help was afforded by Miss M. Arnold of the Public School Department, Sydney. Mr. L. A. Parker, late of the local Commercial Bank, has also rendered able assistance. I have much pleasure in bearing testimony to their intelligence, quickness, and accuracy. These qualifications, as regards calculation by both natural and logarithmic numbers, are in the case of the former especially high.

Proposed Work for the Year 1889.

Within the past few weeks a letter has been received from Professor Newcomb, of Washington, pointing out that he had been engaged for some time in discussing all the good observations of lunar occultations of stars since 1750 at observatories whose longitudes have been determined by telegraph. This work has been interrupted, but in the course of four or five years he proposes to resume it, and to include the Windsor observations in his data. He expressed himself as particularly desirous of having as many occultations as possible from the southern hemisphere. It is, therefore intended to continue the observations of lunar occultations during the year 1889. Observations of the phenomena of Jupiter's satellites will also be carried on as usual. Comets—more particularly those which cannot be seen from the northern hemisphere—will be observed, and occasional phenomena of an important character will also receive due attention. Lastly, the meteorological work, which

now extends over a period of twenty-six years, will be continued with all possible regularity.

Observations Utilised Since 1887.

It is very gratifying to find that in the recent publications, "Untersuchungen über das Cometensystem 1843 I., 1880 I., and 1882 II.," by Dr. Heinrich Kreutz, of Kiel, and "Die Bahn des Periodischen Kometen Winnecke in den Jahren 1858-1886," by Dr. E. Freiherrn von Haerdtl of Innsbruck, the observations made at this observatory have been freely made use of. In the former work Windsor is acknowledged to have been the first station from which the great comet of 1882 was detected near the sun with the unassisted eye, and from which the announcement came that it was moving in an orbit resembling those of the great comets of 1843 and 1880, and that it would in all probability transit the sun's disc. Both these announcements were subsequently verified. The phenomenon of transit was invisible from New South Wales, but its commencement was actually witnessed at the Royal Observatory, Cape of Good Hope. In the latter work the author draws attention to a small systematic difference subsisting between the declinations of Winnecke's comet as obtained at Windsor and those obtained at the Cape of Good Hope and Sydney. It is remarkable that the declinations obtained at Nashville, U.S.A., favour those at Windsor, and that at these two places the observations were made by means of a ring or a square-bar micrometer, while at the Cape and Sydney a filar-micrometer was employed. Had the comet always crossed either the north or the south side of the ring or square we should have some clue for finding the cause of the systematic difference, but under the actual conditions of observing the cause appears to defy discovery.

Conclusion.

It may be added that henceforth it is the author's intention to publish a brief annual report of the work done at the Observatory, and at its close to acknowledge the receipt of all publications which shall be presented to the library.

JOHN TEBBUTT.

PRESENTS RECEIVED FOR THE LIBRARY FROM SEPTEMBER 1st, 1887, TO DECEMBER 31st, 1888.

[Note.—The Names of the Donors are printed in Italics.]

Results of Meteorological Observations in N.S. Wales during 1886. Sydney, 1888, pp. 192.
Results of Rain, River, and Evaporation Observations in N.S. Wales during 1887. Sydney, 1888, pp. 98.
The Government Astronomer for N.S. Wales.

Monthly Records of Results of Observations in Meteorology, Terrestrial Magnetism, &c., at the Melbourne Observatory, with Abstracts from various localities in Victoria. Monthy Parts from June, 1887, to July, 1888.
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Rainfall in South Australia and the Northern Territory. Monthly Returns for 1887, and for January, February, and March, 1888.
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Weather Reports for Hobart. Sheets for August, October, and November, 1887, and for March, April, May, June, July, August, and October, 1888.
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Transit of Venus, 1882. Report of the Committee appointed by the British Government, pp. 88.
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Observations of the Total Solar Eclipse of August 29, 1886, made at Corriacon.

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Annals of Harvard College Observatory, Vol. XVIII., comprising:—
No. 1. Magnitudes of Stars employed in various Nautical Almanacs, pp. 13.
No. 2. Discussion of the Uranometria Oxoniensis, pp. 27.
No. 3. Photometric Observations of Asteroids, by H. M. Parkhurst, pp. 72.
No. 4. Total Eclipse of the Moon, January 28, 1888. With plate.
No. 5. Total Eclipse of the Sun, August 29, 1886, by W. H. Pickering, pp. 27. With plates.
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On Flamsteed's Stars, "Observed, but not Existing," by Professor C. H. F. Peters, pp. 17.
Corrigenda in Various Star Catalogues, by Professor C. H. F. Peters, pp. 13.
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On the Progress of Science, as exemplified in the Art of Weighing and Measuring, by W. Harkness, pp. 48.
On the Colour Correction of Achromatic Telescopes, by W. Harkness, pp. 8.
Refraction in the Principal Meridians of a Triaxial Ellipsoid, &c., by S. M. Burnett, M.D., with a communication on the Monochromatic Aberration of the Human Eye in Aphakia, by Professor W. Harkness, pp. 21.
Professor W. Harkness, U.S.A.

Isochromatic Photography, by F. E. Ives, pp. 5, with plate.
A Lecture on "Matter," including "Radiant Matter," by A. E. Outerbridge, Junr., pp. 11.
On the Fritts' Selenium Cells and Batteries, by C. E. Fritts, pp. 12.
Transportation Facilities of the Past and Present, by W. B. Le Van, pp. 11.
On the Modifications of Tensile Strength and Ductility which Iron and Steel undergo when heated between certain temperatures, by E. Cornut. Transl., pp. 10.
A Simple Form of Draught Gauge, by Professor J. B. Webb, pp. 3.
A General Differential Equation in the Theory of the Deformation of Surfaces, by T. Craig. Philadelphia, 1879, pp. 8.
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Further experiments in Weather Forecast, by P. E. Chase, LL.D., pp. 2.
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Neue Untersuchungen über die Bessel'sche Formel und deren Verwendung in der Meteorologie, von Dr. K. Weihrauch. Dorpat, 1888, pp. 46.

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On the Double Star Σ 1847, by J. E. Gore. Reprint, p. 1.
On the Orbit of *p* Eridani, by J. E. Gore. Reprint, pp. 2.
On the Orbit of the Binary Star O, Struve 234, by J. E. Gore, M.R.I.A., &c. Reprint, pp. 2.

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Ephemeris for Physical Observations of Jupiter, 1888, by A. Marth. Reprint, pp. 10.
Ephemeris for Physical Observations of Mars, 1888, by A. Marth. Reprint, pp. 7.
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Teaching of Geography in the Schools, by J. P. Thomson, M.A., &c., pp. 15.

The Author.

Notes on a Model showing one Form of Serpentine Progression, with diagram, by L. Hargrave. Reprint, pp. 2.

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Light Phenomena of the Atmosphere, by A. M. Cameron, pp. 18.

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Astronomical Revelations.

Anonymous.

REPORT

OF

MR. TEBBUTT'S OBSERVATORY,

THE PENINSULA, WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1889,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, and Corresponding Member of the Ethnographic Institute, Paris, and of the Queensland Branch of the Royal Geographical Society of Australasia.

Sydney:

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1890.

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OF THE

WINDSOR OBSERVATORY

For 1889.

I HAVE much pleasure in presenting to my readers a report of the work at my Observatory during the year 1889. This will be done under various heads, as follow :—

Buildings and Instruments.

No addition has been made either to the buildings or to the instruments since the report for 1888. A complete description of both will be found in the "History and Description of Mr. Tebbutt's Observatory, Windsor, New South Wales." A general notion of the buildings can be formed from the frontispiece of the publication just referred to. It will be sufficient to state that the principal instruments are a 3-inch transit instrument, by Cooke and Sons of York; a sidereal and a mean-time chronometer, by Parkinson and Frodsham and by Poole, respectively; an 8-inch equatorial refractor, by Grubb of Dublin; a 4½-inch equatorial refractor, by Cooke and Sons; and a 3¼-inch refractor, by Jones.

Geographical Position of the Observatory.

No further investigation has been made either of the longitude or of the latitude. These co-ordinates are therefore adopted as $\lambda = 10h.\ 3m.\ 20.51s.$ E. of Greenwich, and $\phi = -33° 36' 30''.8$. (See pages 6 and 7 of the Report for 1888.)

Meridian Work.

This has been done throughout with the 3-inch transit instrument, in connection with sidereal chronometer (Parkinson and Frodsham) No. 1042. The transit system consists of five wires, designated A, B, C, D, and E, in the order of transit above the pole when the clamp is east. The equatorial distances in sidereal time of the four outer wires from the middle wire, determined from all the transits of circumpolar stars in 1887, were:—A + 19.492s. B + 9.782s. D − 10.001s. E − 19.656s. These values were employed throughout the year 1888. A new determination was made from all the transits of circumpolar stars in 1888, with the following results:—A + 19.518s. B + 9.804s. D − 10.003s. E − 19.627s. These values were employed from the beginning of 1889 till May 18, when an accident happened to the system, and a new set of wires was substituted by Mr. Wiesener, of Sydney. Observations with this new system commenced on May 21, and on May 29 provisional values for the equatorial distances were obtained from the transits of twenty-nine circumpolar stars, as follows:—A + 20.084s. B + 10.479s. D − 9.470s. E − 19.070s., the reduction for an equatorial star to the middle wire when all the wires were observed being + 0.405s. These values were employed in the reductions from May 21 to the close of 1889. A subsequent determination from ninety-seven transits of circumpolar stars, between May 21 and December 31, 1889, gave the following results:— A + 20.057s. B + 10.465s. D − 9.458s. E − 19.055s. These will be employed during the year 1890. The reductions during 1889 for complete observations of stars out of the equator have been taken from a MS. table having for its argument the star's declination. For incomplete

transits the reduction for an equatorial star has also been taken from a MS. table giving the algebraic means of the observed wires, and for other stars this quantity has been multiplied by the secant of the star's declination. The observations have all been made by the eye and ear method. The level and azimuth errors of the transit instrument have been as steady as could be expected considering the smallness of the instrument and the foundation of its pier, which consists of strata of clay and loam. The level employed is a striding one of about 1130 feet radius, each division being equal to 0.8″. The inclination was determined once at least on each evening of observation by four readings of each extremity of the bubble, the level being twice reversed during the operation. On some occasions, and always when the transit instrument was reversed, two or more sets of readings were taken. When the western pivot was the higher the level error was regarded as *positive.* The collimation error was determined at intervals of a few days by comparing the middle wire in both positions of the axis of rotation with the corresponding wire of a two-inch transit instrument on a pier a little north of the transit-room. These comparisons were always made near the horizontal wires. As there is no micrometer in connection with the transit system the distance of the middle wire from that of the collimator was estimated for each position of the axis of rotation in terms of the diameter of one of the middle wires. The middle wire of the 3-inch instrument was employed as the standard from the beginning of the year till the accident happened to the wires, and subsequently the middle wire of the collimator was adopted. Half the total displacement reduced to seconds of arc from the known diameter of the standard wire was regarded as the collimation error. When the axis of collimation lies between wires C and D the error of collimation of wire C is always regarded as *positive.* With four exceptions, this has been the case throughout the year 1889, and the corrections for the upper transit have therefore been + or –, according as the clamp was east or west. On every occasion when the instrument was reversed star transits were observed

in both positions of the rotation axis, and, by allowing for chronometer rate, it has been found that the estimations for collimation error were quite as reliable as the results which might be obtained by the application of the micrometer to so small an instrument. The collimation errors for dates between those on which the reversals were made are simply interpolated or assumed. The azimuth error has been determined either from opposite culminations of β Hydri and β Chamæleontis, from contacts and bi-sections of σ Octantis at the middle wire and an approximate chronometer correction, or from transits of a star in high south declination found in the lists of the Greenwich *Nautical Almanac* or the American *Ephemeris*, and one near the equator. In the determinations of azimuth the help afforded by the star list of the latter publication has been invaluable. When the western pivot is too far north the azimuth error is regarded as *positive;* but it may be remarked that during the latter portion of 1887 and throughout 1888 and 1889 it was invariably too far south. The values of the azimuth for intermediate dates, when no azimuth stars could be observed, have been interpolated or assumed, and on these occasions stars as near the zenith as possible were observed for time. Very carefully constructed MS. tables have been employed for the reductions for level, collimation, and azimuth. For all stars north of the zenith a table has been used whose arguments are each degree of declination from $-33°$ to $+56°$, and the values of the level, collimation, and azimuth errors for every second of arc from 1 to 15. The stars for time determinations, irrespective of the azimuth stars, have been taken from those with a declination less than 40° in the Clock Star Lists of the Greenwich *Nautical Almanac* and the American *Ephemeris*. The apparent right ascensions of both clock and azimuth stars have been corrected for daily aberration, but no systematic corrections for equinox have been applied. Where the stars have been found in both publications the right ascensions of the former have been adopted. It may here be added that all time observations out of the meridian in connection with lunar occultations,

phenomena of Jupiter's satellites, comets, etc., have been made with the sidereal chronometer (Parkinson and Frodsham), whose corrected indications are converted into local mean time by employing the sidereal time at Greenwich mean noon of the *Nautical Almanac*, corrected by the quantity – 1m. 39.12s. These conversions have been checked by the use of the mean time of the preceding transit of the First Point of Aries corrected by the quantity + 1m. 38.84s. In the following table will be found a statement of the errors of the transit instrument and the errors and rates of the sidereal chronometer for the year 1889. The instrumental errors in square brackets are simply interpolated or assumed.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			"	"	"		H. M.	M. S.	S.	S.
Jan. 1	4	W.E.	— 2.1	+ 2.3	— 5.85	η Tauri, γ Hydri	4 21	18 41.11		
„ 2	5	E.	— 2.3	[+ 2.4]	— 2.66	η Tauri, γ Hydri	2 54	18 47.12	0.267	0.26
„ 4	3	E.	— 3.1	[+ 2.7]	[— 5.4]		5 21	18 59.28	0.241	0.23
„ 5	3	E.	— 4.1	[+ 2.9]	[— 6 7]		3 30	19 4.33	0.228	0.23
„ 6	9	E.W.	— 4.5	+ 3.0	— 8.05	γ Hydri, A Tauri	3 36	19 10.14	0.241	0.24
„ 8	4	W.	— 5.9	[+ 1.0]	[— 4.9]		5 27	19 22.61	0.250	0.25
„ 9	8	W.E.	— 5.8	0.0	— 3.87	η Tauri, γ Hydri	4 41	19 28.48	0.253	0.24
„ 10	6	E.	— 5.6	[+ 0.1]	— 4.56	η Tauri, γ Hydri	3 35	19 33.78	0.232	0.24
„ 11	5	E.	— 7.8	[+ 0.2]	— 6.11	η Tauri, γ Hydri	3 51	19 39.63	0.245	0.26
„ 12	5	E.	— 6.1	[+ 0.3]	— 3.28	η Tauri, γ Hydri	4 9	19 46.09	0.266	0 27
„ 13	6	E.	— 3.5	[+ 0.4]	[— 3.4]		5 30	19 53.18	0 280	0.28
„ 17	6	E.W.	— 8.4	+ 0.8	— 3.99	η Tauri, γ Hydri	4 19	20 19.80	0.281	0.27
„ 22	2	W.	— 8.5	[+ 0.8]	[— 3.2]		6 57	20 51.73	0.260	0.26
„ 23	3	W.	— 7.6	[+ 0.8]	— 3.01	η Tauri, γ Hydri	4 21	20 57.18	0.255	0.25
„ 25	2	W.	— 7.6	[+ 0.8]	[— 3.5]		4 17	21 8.60	0.238	0.24
„ 28	8	W.E.	— 9.5	+ 0.8	— 5 64	μ Geminorum, Canopus	6 46	21 27.21	0.250	0.25
„ 29	3	E.	— 10.2	[+ 1.0]	[— 5.5]		4 46	21 32.38	0.253	0.24
„ 30	3	E.	— 10.0	[+ 1.1]	[— 5.3]		4 42	21 38.03	0.236	0 24
Feb. 8	2	E.	— 11.6	[+ 2.7]	[— 3.8]		6 8	22 29.89	0.239	0.22
„ 9	3	E.	— 12.0	[+ 2.8]	[— 3.6]		4 42	22 34.90	0.222	0.23
„ 10	9	E.W.	— 12.3	+ 3.0	— 3.40	Melb. 261, ε Orionis	6 2	22 40.83	0.234	0 24
„ 11	10	W.E.	— 13.2	0.0	— 5.22	μ Geminorum, Canopus	6 5	22 46 75	0.246	0 24
„ 12	5	E.	— 12.9	[+ 0.8]	[— 4.9]		5 9	22 52.31	0.241	0.25
„ 13	5	E.	— 11.4	[+ 1.5]	[— 4.5]		4 54	22 58.27	0.251	0 25
„ 15	10	E.W.	— 10.7	+ 3.0	— 3.78	Melb. 261, ε Orionis	5 54	23 10.00	0.239	0.25
„ 16	2	W.	— 10.6	[+ 3.0]	[— 3.9]		7 20	23 15.57	0.219	0.28

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer. H.	M.	Chronometer Fast corresponding to Mean of Group. M.	S.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			″	″	″		H.	M.	M.	S.	S.	S.
Feb. 18	4	W.	—11.5	[+ 3.0]	[—4.0]		5	42	23	27.12	0.249	0.25
„ 21	6	W.E.	—13.7	+ 3.0	—4.26	σ Octantis, S.P.	6	25	23	44.13	0.234	0.23
„ 22	4	E.	—14.2	[+ 2.8]	[—4.4]		5	44	23	49.49	0.230	0.23
„ 23	3	E.	—14.2	[+ 2.6]	[—4.5]		5	34	23	54.77	0.222	0.24
„ 24	4	E.	—12.4	[+ 2.4]	[—4.6]		5	58	24	1.09	0.259	0.26
Mar. 3	7	E.W.	—15.8	+ 1.0	— 6.39 — 5.29	Canopus, γ Geminorum σ Octantis, S.P.	6	31	24	41.06	0.237	0.24
„ 4	5	W.	—15.9	[+ 1.1]	—4.97	σ Octantis, S.P.	7	4	24	47.01	0.242	0.23
„ 5	7	W.	—15.8	[+ 1.3]	—6.00	σ Octantis, S.P.	6	53	24	52.34	0.224	0.24
„ 6	5	W.	—14.5	[+ 1.4]	—3.23	σ Octantis, S.P.	7	36	24	58.58	0.252	0.25
„ 7	10	W.E.	—14.4	+ 1.5	—6.33	γ Geminorum, Melb. 323	6	59	25	4.18	0.240	0.23
„ 8	4	E.	—16.9	[+ 1.4]	—7.41	σ Octantis, S.P.	7	35	25	9.74	0.226	0.23
„ 11	5	E.	—19.8	[+ 0.9]	— 5.22 — 6.18	μ Geminorum, Canopus σ Octantis, S.P.	7	23	25	27.46	0.247	0.24
„ 14	10	E.W.	—23.1 — 8.1	+ 0.5	—8.69	Melb. 323, λ Geminorum	8	22	25	44.95	0.240	0.24
„ 15	5	W.	— 8.4	[+ 0.6]	—4.12	σ Octantis, S.P.	7	31	25	50.44	0.237	0.23
„ 16	3	W.	— 8.8	[+ 0.8]	—3.94	σ Octantis, S.P.	7	11	25	55.82	0.227	0.25
„ 17	6	W.	— 8.6	[+ 0.9]	—3.90	σ Octantis, S.P.	7	12	26	2.20	0.266	0.26
„ 21	7	W.E.	—11.1	+ 1.5	—3.56	σ Octantis, S.P.	7	47	26	25.16	0.238	0.23
„ 22	3	E.	—12.2	[+ 1.5]	[—3.3]		7	34	26	30.68	0.232	0.23
„ 30	3	E.	—19.5 + 3.2	[+ 1.5]	—1.45	α Cancri, ι Argûs	10	7	27	18.74	0.247	0.23
April 1	6	E.W.	+ 4.1	[+ 1.5]	—4.86	β Canis Minoris, Melb. 356	8	12	27	29.40	0.231	0.24
„ 2	2	W.	+ 5.6	[+ 1.4]	—8.57	η Argûs, d Leonis	11	13	27	35.91	0.241	0.23
„ 3	3	W.	+ 4.6	[+ 1.3]	[—8.1]		7	59	27	40.54	0.223	0.23

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			"	"	"		H. M.	M. S.	S.	S.
April 4	3	W.	+ 3.9	[+ 1.8]	— 7.72	Sirius, ζ Mensæ	8 1	27 46.44	0.246	0.24
„ 9	3	W.	+ 3.4	[+ 0.9]	[— 7.6]		8 49	28 14.44	0.232	0.22
„ 10	6	W.E.	+ 1.6	+ 0.8	— 7.59	γ² Piscis ~~Aust.~~ Volantis, δ Gemin.	8 17	28 19.53	0.217	0.22
„ 30	7	E.W.	+ 3.6	+ 0.5	— 5.62 — 6.47	ι Argûs, 10 Leon. Min. ζ Chamæleontis, π Leon.	10 27	30 15.73	0.241	0.31
May 1	4	W.	+ 3.4	[+ 0.4]	— 6.58	θ Chamæleontis, σ Hydræ	8 47	30 20.66	0.310	0.25
„ 2	4	W.	+ 3.3	[+ 0.4]	[— 5.2]		11 48	30 27.76	0.189	0.22
„ 3	4	W.	+ 3.7	[+ 0.3]	— 3.82	θ Hydræ, β Argûs	9 54	30 33.48	0.259	0.25
„ 5	3	W.	+ 3.7	[+ 0.1]	— 4.66	β Chamæleontis, β Hydri	11 46	30 44.97	0.230	0.23
„ 7	7	W.E.	+ 3.8	+ 0.0	— 9.47	β Chamæleontis, β Hydri	12 8	30 56.08	0.230	0 22
„ 9	5	E.	+ 2.4	[+ 0.3]	— 7.16	β Chamæleontis, β Hydri	12 11	31 6.20	0 211	0.21
„ 10	4	E.	+ 2 8	[+ 0.4]	— 9.10	η Bootis, θ Apodis	14 10	31 11.58	0.207	0.21
„ 12	3	E.	+ 1.9	[+ 0.7]	[— 7.4]		9 8	31 20.92	0.217	0.23
„ 13	6	E.W.	+ 2.3	+ 0.8	— 7.77 — 6.64	θ Hydræ, β Argûs β Chamæleontis, β Hydri	11 13	31 26.94	0.231	0.23
„ 14	5	W.	+ 2.2	[+ 0.8]	— 6.43	β Chamæleontis, β Hydri	12 40	31 32.74	0.228	0.22
„ 16	5	W.	+ 2.0	[+ 0.8]	— 6.14	β Chamæleontis, 20 Comæ	11 13	31 43.03	0.221	0.22
„ 18	3	W.	+ 1.7	[+ 0.8]	[— 6.1]		10 44	31 58.28	0 216	0.23
„ 21	8	W.E.	+ 2.2	+ 2.6	— 11.99 — 6.95	o Leon., ζ Chamæleontis β Chamœleontis, β Hydri	11 24	32 11.08	0.245	0.25
„ 21	2	E.	+ 2 9	[+ 2.7]	[— 7.7]		20 11	32 13.34	0.257	0.24
„ 22	7	E.W.	+ 2.6	+ 2.8	— 8 47 — 8.93	o Leon., ζ Chamæleontis β Chamæleontis, β Hydri	11 43	32 16 55	0.206	0.21
„ 29	5	W.E.	+ 15.1	+ 0.5	— 8.57	η Octantis, δ Leonis	12 7	32 53.84	0.221	0.22
„ 30	4	E.	+ 16 1 + 0.3	[+ 0.9]	[— 7.8]		11 17	32 58.92	0.219	0.22

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			"	"	"		H. M.	M. S.	s.	s.
June 2	5	E.	+ 3.4	[+ 2.1]	— 5.40	β Chamæleontis, β Hydri	12 8	33 15.96	0.234	0.22
„ 3	7	E.W.	+ 3.4	+ 2.5	— 6.04	β Chamæleontis, β Hydri	13 5	33 21.53	0.223	0.22
„ 5	6	W.	+ 4.9	[+ 2.0]	— 8.89	β Chamæleontis, β Hydri	12 55	33 31.67	0.212	0.22
„ 7	6	W.	+ 4.7	[+ 1.5]	— 9.06 — 9.23	η Bootis, θ Apodis κ Virginis, δ Octantis	14 50	33 42.76	0.222	0.21
„ 8	6	W.E.	+ 4.4	+ 1.2	— 12.63 — 13.77	δ Virginis, δ Muscæ κ Octantis, *m* Virginis	18 15	33 47.80	0.208	0.21
„ 9	5	E.	+ 5.3	[+ 1.2]	— 10.26	*d* Leonis, η Octantis	12 24	33 52.27	0.215	
„ 9	3						18 55	0 8.30		
„ 10	6	E.	+ 5.1	[+ 1.2]	— 12.06	β Chamæleontis, β Hydri	12 59	0 13.75	0.236	0.22
„ 11	5	E.	+ 5.3	[+ 1.2]	— 11.29	o Virginis, β Chamæleontis	12 24	0 18.44	0.200	0.20
„ 13	9	E.W.	+ 5.0	+ 1.0	— 12.06	β Chamæleontis, β Hydri	11 44	0 27.87	0.199	0.20
„ 16	1	W.	+ 6.3	[+ 1.5]	[— 14.2]		12 5	0 42.59	0.204	0.19
„ 17	6	W.	+ 6.3	[+ 1.7]	— 14.94	δ Virginis, δ Muscæ	12 56	0 47.35	0.192	0.20
„ 18	8	W.	+ 5.9	[+ 1.9]	— 10.60	τ Bootis, θ Apodis	18 36	0 52.61	0.213	0.20
„ 20	1	W.	+ 6.1	[+ 2.2]	[— 10.3]		12 37	1 1.33	0.186	0.22
„ 21	7	W.E.	+ 6.9	+ 2.4	— 10.20 — 11.15	β Chamæleontis, β Hydri κ Octantis, ζ Virginis	12 55	1 6.89	0.229	0.21
„ 22	2	E.	+ 6.1	[+ 2.4]	[— 10.1]		12 1	1 11.30	0.191	0.20
„ 23	2	E.	+ 5.9	[+ 2.4]	[— 9.0]		23 31	1 18.85	0.213	0.22
„ 24	5	E.	+ 6.2	[+ 2.5]	— 7.94	β Chamæleontis, β Hydri	12 18	1 21.65	0.219	0.20
„ 25	2	E.	+ 6.0	[+ 2.5]	[— 8.9]		14 48	1 26.64	0.188	0.19
„ 26	2	E.	+ 5.5	[+ 2.5]	[— 8.9]		15 7	1 31.16	0.186	0.18
„ 26	3	E.	+ 5.4	[+ 2.5]	— 9.83	γ^1 Octantis, ω Piscium	23 44	1 32.73	0.182	0.18
„ 29	7	E.W.	+ 6.0	+ 2.6	— 8.69	β Chamæleontis, β Hydri	13 5	1 44.40	0.190	0.20
„ 30	8	W.	+ 5.9	[+ 2.3]	[— 9.0]		12 2	1 49.74	0.233	0.22

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			″	″	″		H. M.	M. S.	s.	s.
July 1	2	W.	+ 6.4	[+ 1.9]	[— 9.4]		13 26	1 55.25	0.217	0.21
„ 2	4	W.	+ 7.2	[+ 1.6]	— 9.73	ρ Octantis, α Serpentis	15 41	2 0.48	0.199	0.19
„ 4	8	W.E.	+ 7.9	+ 1.0	— 11.73	α Tri. Aust., κ Ophiuchi	16 30	2 9.51	0.185	0.19
„ 5	2	E.	+ 7.5	[+ 1.2]	— 10.18	β Chamæleontis, β Hydri	12 22	2 13.40	0.196	0.19
„ 7	5	E.	+ 7.6	[+ 1.7]	— 11.91	τ Virginis, α Apodis	14 27	2 21.80	0.168	0.17
„ 10	8	E.W.	+ 8.7	+ 2.4	— 7.88	ρ Octantis, α Cor. Borealis	15 25	2 35.35	0.186	0.18
„ 14	5	W.	+ 8.9	[+ 1.8]	— 12.53	τ Virginis, δ Octantis	14 37	2 51.54	0.170	0.17
„ 23	5	W.E.	+ 10.8	+ 0.4	— 10.96	τ Virginis, δ Octantis	14 19	3 32.52	0.190	0.19
„ 24	2	E.	+ 9.9	[+ 0.4]	[— 11.4]		15 38	3 37.38	0.192	0.19
„ 27	4	E.	+ 10.5	[+ 0.5]	— 12.64	τ Virginis, δ Octantis	15 45	3 49.81	0.172	0.18
„ 29	8	E.W.	+ 11.8	+ 0.6	— 11.69	ρ Bootis, α Apodis	14 26	3 58.45	0.185	0.18
„ 31	4	W.	+ 11.6	[+ 0.5]	[— 11.2]		19 11	4 7.51	0.172	0.17
Aug. 10	3	W.	+ 13.3	[+ 0.1]	— 8.40	γ Aquilæ, ε Pavonis	20 4	4 47.67	0.167	0.18
„ 12	7	W.E.	+ 14.2	+ 0.0	— 9.05	ρ Octantis, α Serpentis	15 47	4 55.43	0.178	0.18
„ 13	4	E.	+ 13.7	[+ 0.4]	[— 9.8]		14 43	4 59.55	0.180	0.18
„ 14	4	E.	+ 13.6	[+ 0.7]	[— 10.5]		14 47	5 4.12	0.190	0.19
„ 15	4	E.	+ 13.6	[+ 1.1]	— 11.25	δ¹ Apodis, δ Ophiuchi	15 50	5 8.71	0.183	0.19
„ 16	2	E.	+ 13.7	[+ 1.5]	— 4.56	α Tri. Aust., α Ophiuchi	17 28	5 13.72	0.196	0.18
„ 17	3	E.	+ 13.8	[+ 1.9]	— 10.88	α Tri. Aust., κ Ophiuchi	17 9	5 17.68	0.167	0.17
„ 19	9	E.W.	+ 13.3	+ 2.6	— 11.60	α Tri. Aust., κ Ophiuchi	17 9	5 26.61	0.186	0.19
„ 20	5	W.	+ 13.1	[+ 2.4]	— 14.87	α Tri. Aust., κ Ophiuchi	16 35	5 31.22	0.197	0.21
„ 21	6	W.	+ 13.2	[+ 2.1]	— 12.78	α Tri. Aust., κ Ophiuchi	17 4	5 36.70	0.224	0.21
„ 23	6	W.	+ 14.7	[+ 1.6]	— 12.71	α Tri, Aust., κ Ophiuchi	16 48	5 45.99	0.195	0.19
„ 24	8	W.E.	+ 14.8	+ 1.4	— 10.75	α Tri. Aust., κ Ophiuchi	16 41	5 50.45	0.187	0.19
Sept. 1	2	E.	+ 16.0	[+ 1.2]	[— 12.3]		21 56	6 31.46	0.208	0.19
„ 4	4	E.	+ 16.2	[+ 1.1]	— 12.01	ε Delphini, β Pavonis	20 39	6 44.50	0.184	0.18

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast or Slow corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			"	"	"		H. M.	M. S.	S.	S.
Sept. 6	2	E	+ 15.8	[+ 1.0]	[— 11.5]		18 12	6 52.54	0.177	0.21
„ 7	6	E.W.	+ 17.2	+ 1.0	— 11.27	α Tri. Aust., κ Ophiuchi	17 43	6 57.72	0.220	0.22
„ 8	3	W.	+ 17.9	[+ 1.0]	[— 9.8]		19 28	7 3.55	0.226	0.24
„ 9	4	W.	+ 18.0	[+ 1.0]	— 8.40	γ Aquilæ, ε Pavonis	19 52	7 9.76	0.255	0.25
„ 13	3	W.	+ 18.3	[+ 1.0]	[— 9.3]		19 43	7 29.79	0.209	0.22
„ 26	1	W.	+ 18.7	[+ 1.0]	[— 12.1]		21 47	8 43.53	0.235	0.23
„ 27	6	W.E.	+ 19.0 + 2.4	+ 1.0	— 12.30	ε Delphini, β Pavonis	20 17	8 48.72	0.231	0.23
„ 30	6	E.	+ 1.8	[+ 1.1]	— 12.52	ε Delphini, β Pavonis	20 50	9 7.98	0.266	0.24
Oct. 1	5	E.	+ 1.4	[+ 1.1]	— 11.17	α Aquarii, υ Octantis	21 6	9 13.68	0.285	0.23
„ 2	4	E.	+ 1.4	[+ 1.2]	[— 11.0]		20 44	9 18.94	0.223	...
„ 23	7	E.W.	+ 4.1	+ 2.0	— 7.66	α Aquarii, υ Octantis	22 15	2 46.50	...	...
„ 24	3	W.	+ 5.4	[+ 2.1]	[— 8.4]		21 10	2 40.79	0.249	0.25
„ 25	4	W.	+ 5.8	[+ 2.2]	[— 9.1]		22 36	2 34.45	0.249	0.25
„ 28	8	W.E.	+ 6.4	+ 2.6	— 11.30	υ Octantis, η Aquarii	22 9	2 15.58	0.264	0.27
Nov. 3	4	E.	+ 4.3	[+ 2.8]	— 10.34	α Aquarii, υ Octantis	22 14	1 35.57	0.278	0.26
„ 5	1	E.	+ 4.6	[+ 2.9]	[— 10.0]		22 50	1 23.01	0.258	0.26
„ 7	8	E.W.	+ 4.8	+ 3.0	— 9.71	β Chamæleontis, β Hydri	0 23	1 10.28	0.257	0.24
„ 8	3	W.	+ 4.8	[+ 2.9]	[— 9.7]		0 43	1 4.79	0.226	0.23
„ 19	1	W.	+ 5.3	[+ 2.1]	[— 9.3]		23 21	0 2.30	0.234	0.24
„ 20	7	W.E.	+ 5.4	+ 2.0	— 9.32	β Chamæleontis, β Hydri	23 39	0 8.23	0.244	0.25
„ 27	8	E.W.	+ 5.6	+ 3.6	— 9.13	β Chamæleontis, β Hydri	0 38	0 52.24	0.260	0.24
„ 30	6	W.	+ 6.0	[+ 3.1]	— 10.21	β Hydri, δ Piscium	0 15	1 8.86	0.232	0.25
Dec. 1	4	W.	+ 6.7	[+ 3.0]	[— 9.9]		23 44	1 14.74	0.250	0.25
„ 13	6	W.E.	+ 6.2	+ 1.0	— 6.29	β Hydri, δ Piscium	1 1	2 27.79	0.253	0.2[illegible]
„ 14	3	E.	+ 6.1	[+ 1.2]	[— 6.4]		2 23	2 33.25	0.215	0.22

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast corresponding to Mean of Group.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Group.
1889.			"	"	"		H. M.	M. S.	S.	S.
Dec. 21	7	E.W.	+ 5.8	+ 2.4	— 7.15	ε Tauri, δ Mensæ	2 8	3 17.29	0.268	0.26
„ 22	3	W.	+ 5.2	[+ 2.3]	[— 6.8]		1 47	3 23.45	0.260	0.26
„ 25	3	W.	+ 6.4	[+ 2.0]	— 5.86	δ Hydri, γ Ceti	2 39	3 41.94	0.254	0.27
„ 26	2	W.	+ 6.8	[+ 1.8]	[— 5.8]		3 3	3 48.55	0.271	0.27
„ 30	8	W.E.	+ 5.0	+ 1.4	— 5.67	μ Hydri, γ Ceti	2 24	4 12.47	0.251	0.23
„ 31	6	E.	+ 4.8	[+ 1.4]	— 5.80	μ Hydri, γ Ceti	2 14	4 17.86	0.226	...

NOTES.

The eastern pivot was lowered during the observations of March 14 and 30.

An accident occurred to the transit wires on May 18, and a new set was substituted between May 18 and 21. (See Report.)

On May 30 the eastern pivot was raised during the observations, the sudden rise of the western pivot between May 22 and 29 being probably due to the recent unprecedented rains, 19.968 inches having fallen in three days ended 9h. a.m. on 28.

The chronometer, which is wound every Saturday evening, was allowed to run down on June 9, and was started again the same evening with a small error.

The eastern pivot was raised during the observations of September 27.

The chronometer ran down during my absence from home from October 4 to 16; it was started again on October 18 with a small error slow.

Extra-Meridian Work.

Although there has been a very large proportion of cloudy nights during the year, a considerable amount of work has been done in this department. The following is a *resumé* :—

Occultations of Stars by the Moon.—The occultations of thirty-two stars were observed chiefly with the 8-inch equatorial, comprising thirty-two disappearances at the dark and two reappearances at the bright limb. Twenty-six of the stars have been identified. The results have been forwarded to the *Astronomische Nachrichten.* The total number of occultation phases observed here during the period 1864-1889 is 406—namely, 393 disappearances and 13 reappearances.

Phenomena of Jupiter's Satellites.—These have been observed chiefly with the 8-inch equatorial, and are classified thus:—Transit-ingress, I.2, II.2, III.1, IV.1; Transit-egress, I.3, II.1, III.2, IV.1. Occultation-disappearances, I.1, II.1; Occultation-reappearances, I.3. Eclipse-disappearances, I.3, III.2; Eclipse-reappearances, I.1, II.1, III.1. These results have been forwarded to the Royal Astronomical Society.

Observations of Minor Planets.—Three minor planets were observed with the filar-micrometer of the 8-inch equatorial, as follows:—Juno (3), on February 22, March 3, 5, 6, 11, 15, 16, 17, 21, April 1, 2, comprising 119 comparisons and 9 comparison stars; Hebe (6), on September 1, 4, 7, 8, 9, embracing 45 comparisons and 7 comparison stars; and Flora (8), on August 10, 12, 13, 14, 19, 20, 21, 23, embracing 81 comparisons and 10 comparison stars. All the observations have been completely reduced and sent to the *Astronomische Nachrichten.*

Comets.—The following comets were observed with the square bar-micrometer, the 4½-inch equatorial being employed on August 14, 15, and the 8-inch instrument on all the other dates:—Comet I. (Barnard), 1889, on Jan. 2, 4, 5, 6, June 23, 26, 29, July 1, comprising 70 comparisons and 8 comparison stars. Comet IV. (Davidson), 1889, on July 23, 24, 27, 28, 29, 31, August 14, 15, comprising

62 comparisons and 14 comparison stars; and Comet V. (Brooks, July 6), 1889, on October 25, 28, embracing 10 comparisons and 3 comparison stars. These observations have been all reduced and sent to the *Astronomische Nachrichten*. Brorsen's periodical comet was carefully searched for, with the help of Dr. E. Lamp's ephemeris, on December 21, 25, 1889, and again on January 18, 20, 22, 1890, but without success. It may be remarked that on the last three occasions its apparent brilliancy was given by Dr. Lamp as 0.86 to 1.05; whereas when the comet was observed with the 4½-inch equatorial at Windsor on February 26, 1879, its theoretical brilliancy was only 0.62. The ephemeris must either be greatly in error, or the comet has very much diminished in brilliancy since the last observed return. After January 22 the moon began to show in the west, so that it was useless to attempt a further search.

DOUBLE STARS.—The well-known binaries, p Eridani and γ Coronæ Australis, were observed on several occasions. The measures of the latter star have been made at the request of Mr. Gore, of Ballisodare, Ireland, who is engaged in a re-calculation of the orbit.

VARIABLE STARS.—Comparisons have been made both of η Argûs and R Carinœ with the neighbouring stars by means of the 3¼-inch refractor, and of the latter star with the naked eye also. The former star has not sensibly varied in its lustre since the announcement of its sudden increase of magnitude between April, 1887, and May, 1888. A very satisfactory determination of the maximum of the latter star was made in June, 1889. The period of this remarkable variable was given by the author as 312 days in *R.A.S. Monthly Notices*, vol xlvi., p. 487. Professor Chandler, of Cambridge, Mass., U.S.A., has since carefully discussed the recorded observations, and found the period to be 312.14 days, a result which agrees very closely with my own.

Meteorological Observations.

The usual 9h. a.m. observations have been kept up with great regularity during the year. They comprise observations of the barometer, maximum and minimum

temperature of the air and evaporation, maximum solar radiation, and minimum radiation on the grass, rainfall and evaporation, direction of the wind, and cloud extent, as in former years. The results for 1886, 1887, 1888, and 1889 will shortly be published. Since 1862 the rainfall results have been forwarded annually to the Government Astronomer for incorporation with similar results from the Government Meteorological Stations. Last year a self-registering tide-gauge was established on the South Creek in the meridian of the Observatory, and the times and heights of upwards of six hundred tides were duly recorded.

Publications.

The following is a list of the papers published by the author in journals and transactions of scientific societies since the report for 1888:—

Observations of the Phenomena of Jupiter's Satellites at Windsor, N. S. Wales in the Year 1888.—*R.A.S. Monthly Notices*, vol. xlix., p. 329. (See Report for 1888, p. 19.)

Lunar Occultations of Stars Observed at Windsor, N. S. Wales in 1888.—*Ast. Nachrichten*, Band cxxi., No. 2887, p. 103. (See Report for 1888, p. 19.)

Mean Places of Stars Compared with Comet 1886, II. (Barnard).—*Ast. Nach.*, Band cxxi., No. 2889, p. 139. This paper contains the places for 1889·0 of three stars determined and kindly communicated by the Government Astronomer for Victoria. They were determined at the request of Pfarrer A. Thraen, of Dingelstadt, who is engaged in a definitive investigation of the orbit of the comet.

Observations of Comet 1889, I. (Barnard, 1888, Sept. 2), at Windsor, N. S. Wales, with the 8-inch Equatorial and Square Bar - Micrometer.—*Ast. Nach.*, Band cxxi., No. 2894, p. 221. (See Reports for 1888 and 1889, pp. 21 and 17 respectively.

On the High Tides of June 15-17, 1889.—*Journal and Proceedings of the Royal Society of N.S. Wales*, vol. xxiii., p 51.

OBSERVATIONS OF COMET 1889 (DAVIDSON), WITH THE 8-INCH EQUATORIAL OF THE WINDSOR OBSERVATORY AND SQUARE BAR-MICROMETER.—*Ast. Nach*, Band cxxii., No. 2924, p. 349. These comprise observations made on the first two days only, namely, 1889—July 23, 24.

FURTHER OBSERVATIONS OF COMET 1889, I., AT WINDSOR, N.S. WALES.—*Ast. Nach.*, Band cxxiii., No. 2934, p. 89, (See page 17 of this Report.)

RESULTS OF DOUBLE-STAR MEASURES AT WINDSOR, N.S. WALES. IN 1886, 1887, AND 1888.—*R.A.S. Monthly Notices*, vol. L., p. 23. These comprise measures both in position-angle and distance of forty-six southern stars. α Centauri was observed with the $4\frac{1}{2}$-inch equatorial on two occasions. All the other observations were made with the 8-inch instrument. Among the data given are the hour angles between which the measures were taken.

The Library.

In a list at the close of this report will be found an acknowledgment of all presents received during the year 1889. For these expressions of sympathy with his work the author desires again to offer his warmest thanks.

Personal Establishment.

From the foundation of the Observatory to the present time the astronomical observations have been made solely by the author himself. The same may be said of nearly the whole of the meteorological observations. He has also to execute the greater and more difficult part of the reductions. The occasional services of an ordinary computer are required, but it has usually been found extremely difficult to get such assistance on the spot. During the Christmas vacation considerable help was afforded by Miss M. Arnold, of the Public School Department, Sydney, whose intelligence, quickness and accuracy have been thoroughly tested. Check calculations have always been applied when required.

Proposed Work for the Year 1890.

In consequence of his close application to work during the past few years the author finds it necessary

to secure partial rest. It is proposed, therefore, to observe only occultations of stars by the moon and the positions of southern comets, and to continue the meteorological work as usual.

Observations Utilised since the last Report.

The observations of comet 1884, II. (Barnard), made at Windsor in that year, and those published by eighteen other observatories, have been fully made use of by Herr A. Berberich, of the Recheninstitut, Berlin, in his elaborate paper, "Bahnbestimmung des periodischen Cometen, 1884, II. (Barnard)," in *Ast. Nachrichten*, Band cxxiii., Nos. 2938, 2939, p. 145. The Windsor observations were made with the 4½-inch equatorial, and have turned out well. The comet proves to have a period of only 1972 days.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1889.

[NOTE.—The Names of the Donors are printed in Italics.]

The Source of the Underground Water in the Western Districts, by H. C. Russell, F.R.S., &c., pp. 7.
Results of Rain, River and Evaporation Observations in N. S. Wales during 1888, by H. C. Russell, F.R.S., &c., pp. 144, with maps. Two copies.
The Thunderstorm of October 26, 1888, by H. C. Russell, F.R.S., &c., pp. 2.
The Storm of September 21, 1888, by H. C. Russell, F.R.S., &c., pp. 3.
On a New Self-Recording Thermometer, by H. C. Russell, F.R.S.. &c., with diagram, pp. 3.
Results of Meteorological Observations in N. S. Wales, 1887, by H. C. Russell, F.R.S., &c., pp. 285, with diagrams.
Proposed Method of Recording Variations in the Direction of the Vertical, by H. C. Russell, F.R.S., &c., pp. 3.
Astronomical and Meteorological Workers in N. S. Wales, 1778-1860, by H. C. Russell, F.R.S., &c., pp. 49.
President's Address at the First Meeting of the Australasian Association for the Advancement of Science, by H. C. Russell, F.R.S., &c., pp. 21.

The Government Astronomer for N. S. Wales.

Monthly Records of Results of Observations in Meteorology, Terrestrial Magnetism, &c , at the Melbourne Observatory, with Abstracts from Various Localties in Victoria. Monthly parts from August, 1888, to September, 1889.
Results of Astronomical Observations at the Melbourne Observatory in 1881, 1882, 1883 and 1884, by R. L. J. Ellery, F.R.S., &c., pp. 131.

The Government Astronomer for Victoria.

Rainfall Returns for South Australia, in monthly parts, April, 1888, to September, 1889.

The Government Astronomer for South Australia.

Weather Reports for Hobart, Tasmania. Monthly sheets, from November, 1888, to November, 1889, February missing.
Rainfall Map, 1888, for Tasmania.
Meteorological Observations at Hobart and other Places in Tasmania in 1888.

The Government Meteorological Observer for Tasmania.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia. 1887-88—Vol. III., Part II., pp. 123; 1889—Vol. IV., pp. 85: 1889-90—Vol. V., Part I., pp. 42, with maps.

Queensland Branch of the Royal Geog. Society of Australasia.

Observations of Comet of July and August, 1889, at Launceston, Tasmania, by A. B. Biggs, p. 1.

Recent Measures of α Centauri, by A. B. Biggs, p. 1.

A New Dark-Field Micrometer for Double Star Measurement, with diagrams, by A. B. Biggs, pp. 4.

On Some Tide Observations at Hobart during February and March, 1889, by A. Mault, pp. 4.

The Royal Society of Tasmania

The Surveyor. Monthly parts, February to December, 1889.

The Survey Club, Sydney.

Meteorological Observations at Stations of the Second Order for 1884, pp. 232; and 1885, pp. 232.

Hourly Readings, 1885, Part IV., October—December; and 1886, four parts.

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Report of the Fourth Meeting of the International Meteorological Committee, Zurich, September, 1888.

Quarterly Weather Report, Part IV., October—December, 1879.

Weekly Weather Reports, May 14, 1888, to September 2, 1889, complete, with Summaries.

The Meteorological Office, London.

Report of the Kew Observatory for the year ending October 31, 1888.

The Kew Observatory.

Results of Astronomical and Meteorological Observations at Radcliffe Observatory for 1885, pp. 129.

The Radcliffe Trustees.

Results of Meteorological and Magnetic Observations at Stonyhurst College Observatory, by Rev. S. J. Perry, S. J., F.R.S., &c. 1887. pp. 92; 1888, pp. 97.

Rev. S. J. Perry, S.J, F.R S., &c

Report of the Rousdon Observatory, Lyme Regis, for 1888. Sheet.

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Astronomical Papers for the Use of the American Ephemeris, by S. Newcomb, Ph. D., &c., Vol. I., pp. 487.

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The Williams College Catalogue of North Polar Stars, R.As. for 1885·0, by T. H. Safford, Ph. D., pp. 57.
Williams College Observatory, U.S.A.

Report of Yale University Observatory for 1888-89.
The Observatory, Yale University, U.S.A.

Annals of Harvard College Observatory, Vol. XVIII., No. VI. Detection of New Nebulæ by Photography, pp. 5.
Harvard College Observatory, U.S.A.

Monthly Weather Review, Meteorological Service of the Dominion of Canada, September, 1888, to August, 1889
Toronto General Meteorological Register for 1888.
The Meteorological Office, Toronto.

Anuario del Observatorio Astronomico Nacional de Tacubaya, 1889. pp. 377.
The Observatory, Tacubaya.

Annales de l'Observatoire Imperial de Rio de Janeiro, Tome III.
Revista do Imperial Observatorio do Rio de Janeiro, Jan., Fev., Mar., Junho, Julho, and Agosto, 1889.
The Imperial Observatory, Rio de Janeiro.

Anuario del Observatorio de la Plata, 1889, pp. 541.
The Observatory, La Plata.

La Periode Solaire, les Essaims d'Etoiles Filantes et les Perturbations Magnetiques, par Ch. v. Zenger, pp. 6.
Mag. und Met. Beobachtungen an der k. k. Sternwarte zu Prag in 1888, pp. 65.
Observatoire Astrophysique, Prague.

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Hydrographischen Amte zu Pola.

Dorpat Meteorologischen Beobachtungen, Mai, 1888, to Dec., 1888.
Bericht über die Ergebnisse der Beobachtungen au den Regenstationen für 1887, pp. 14.
The Meteorological Observatory, Dorpat.

Annales de l'Observatoire de Tachent. Tome II., in Russian text.
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Beobachtungen au der Centralanstalt für Meteorologie, &c., Hohe Warte, bei Wien, Juli, 1888—Jan., 1889.
Hohe Warte, bei Wien.

Observations des Etoiles de la Zone outre 75° et 80° N. a l'Observatoire de l'Université Imperiale de Kasan. Tome II., pp. 135.
The Imperial Observatory, Kasan.

Osservazioni sulla Stella Doppie, 1875—1885 da G. V. Schiaparelli, pp. 229, with diagrams.
The Observatory, Brera, Milan.

Publicationen der v' Kuffner'schen Sternwarte in Wien (Ottakring) Band I., pp. 216, with plates.
v' Kuffner'schen Sternwarte, Wien.

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Untersuchungen über das Cometensystem—1843, I.; 1880, I.; und 1882, II., Theil I. Der Grosse September Comet, 1882, II., von Dr. Heinrich Kreutz, pp. 111.
Das Æquinoctium für 1860.0, von Dr. E. Lamp, pp. 55.
Zusammenstellung der Cometen-Erscheinungen des Jahres, 1888, pp. 9. Von Dr. H. Kreutz.
Dr. H. Kreutz, Kiel.

Die Bahn des periodischen Cometen Winnecke in den Jahren, 1858—1886, von Dr. E. F. von Haerdtl, Theilen I. und II., pp. 96 and 38.
The Author.

Sur le Ligament Lumineux des Passages et Occultations des Satellites de Jupiter, Moyen de l'eviter, par M. Ch. André, pp. 5.
The Author.

Sur l'Origine des Etoiles Filantes, par Th. Bredichin, A.R.A.S., pp. 60, with diagram.
The Author.

A Table of the Positions of Observatories, with Constants Useful in Correcting Extra-Meridian Observations for Parallax, by Lieut.-General Tennant, F.R.S., pp. 12.
On the Determination of Normal Places, by Lieut.-General Tennant, F.R.S., pp. 4.
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The Author.

Ephemerides of the Satellites of Saturn, 1888-89, by A. Marth, pp. 13.
Ephemeris of the Satellite of Neptune, 1888-89, by A. Marth, pp. 2.
Ephemeris for Physical Observations of the Moon, 1889, January 1—April 1, by A. Marth, pp. 3.
Ephemerides of the Satellites of Saturn, 1888-89, by A. Marth, pp. 9.
Ephemeris for Physical Observations of the Moon, 1889, April 1—June 30, by A. Marth, pp. 3.
Ephemeris of the Satellites of Uranus, 1889, by A. Marth, pp. 4.
Ephemeris for Physical Observations of the Moon, 1889, July —1890, Jan. 1, by A. Marth, pp. 6.
Ephemeris for Physical Observations of Jupiter, 1889, by A. Marth, pp. 10.
On the Close Conjunction of Mars and Saturn near Regulus, Sept. 19, 1889, by A. Marth, pp. 4.
On the Eclipse of Iapetus by Saturn and its Ring System on Nov. 1-2, 1889, by A. Marth, pp. 3
Ephemerides of the Satellites of Saturn, 1889-90, by A. Marth, pp. 10.
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The Eclipses of Jupiter's Satellites, by A. M. W. Downing, M.A., pp. 9.
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On the Spectrum Visible and Photographic of the Great Nebula in Orion, by W. Huggins, LL.D., F.R.S., &c., and Mrs. Huggins, pp. 22, with diagrams.
On the Wave Length of the Principal Line in the Spectrum of the Aurora, by W. Huggins, LL.D., F.R.S., &c., pp. 7.

The Authors.

Observations of the Variable Star *S* (10) Sagittæ, by J. E. Gore, p. 1.
On the Proper Motion of 85 Pegasi, by J. E. Gore, p. 1.
On the Variable Star μ Cephei, by J. E. Gore, F.R.A.S., pp. 7.

The Author.

The Great Storm off the Atlantic Coast of the United States, March 11-14, 1888, by E. Hayden, pp. 65, with coloured plates.

Lieut. G. L. Dyer, U.S.N.

Egeson's Weather System of Sunspot Causality, by C. Egeson, pp. 63, with diagrams.
Meteorological Papers in the "Pastoralist" for May 10, 17, 24, 31, June 7 and 14, 1889, by C. Egeson.
Climatological Charts for Australia for July and August, 1889, by C. Egeson.
Daily Areas of Rainfall in New South Wales for January, February, March, September and October, 1889, by C. Egeson.

The Author.

Magnetic Disturbances, by Rev. G. T. Carruthers, pp. 7.

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Light Science for Leisure Hours, by R. A. Proctor, B.A., Lond., 1883, pp. 309.
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The Author.

REPORT

OF

MR. TEBBUTT'S OBSERVATORY,

THE PENINSULA, WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1890,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales; Member of the Astronomical Society of the Pacific; and Corresponding Member of the Ethnographic Institute, Paris, and of the Queensland Branch of the Royal Geographical Society of Australasia.

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1891.

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REPORT

OF THE

WINDSOR OBSERVATORY

For 1890.

THE following is a report of the work done at my Observatory during the year 1890:—

Buildings and Instruments.

No addition has been made either to the buildings or to the instruments during the year. A complete description of both will be found in the "History and Description of Mr. Tebbutt's Observatory, Windsor, New South Wales." A general notion of the buildings can be formed from the frontispiece to the publication just referred to. The principal instruments are a 3-inch transit instrument, by Cooke and Sons of York; a sidereal and meantime chronometer, by Parkinson and Frodsham and by Poole respectively; an 8-inch equatorial refractor, by Grubb of Dublin; a $4\frac{1}{2}$-inch equatorial refractor, by Cooke and Sons; and a $3\frac{1}{4}$-inch refractor, by Jones.

Position of the Observatory.

The co-ordinates of the Observatory are as follow:—Longitude from Greenwich = 10h. 3m. 20.51s. E.; astronomical latitude = — 33° 36′ 30.8″. (See pages 6 and 7 of the Report for 1888.)

Meridian Work.

This has been done throughout with the 3-inch transit instrument, in connection with sidereal chronometer *Parkinson* and *Frodsham* No. 1042. The transit system consists of five wires, designated A, B, C, D, and E, in the order of transit above the pole when the clamp is east. The equatorial distances in sidereal time of the four outer wires from the middle wire, as determined from transits of ninety-seven circumpolar stars between May 20, 1889, and January 1, 1890, are:—A + 20.057s. B + 10.465s. D — 9.458s. E — 19.055s. These give a reduction of + 0.402s. to the middle wire, and were employed throughout the year 1890. A subsequent determination from all the transits of circumpolar stars in 1890 gives the following equatorial values:—A + 20.040s. B + 10.466s. D — 9.468s. E — 19.019s., with a reduction of + 0.404s. to the middle wire. These values will be employed during the year 1891. The reductions during 1890 for complete observations of stars out of the equator have been taken from a MS. table having for its argument the star's declination. For incomplete transits the reduction for an equatorial star has also been taken from a MS. table giving the algebraic means of the observed wires, and for other stars this quantity has been multiplied by the secant of the star's declination. The observations have all been made by the eye and ear method. The level collimation and azimuth errors have been as steady as in former years. The level employed is a striding one of about 1130 feet radius, each division being equal to 0.8″. The inclination was determined once at least on each evening of observation by four readings of each extremity of the bubble, the level being twice reversed during the operation. On some occasions,

and always when the transit instrument was reversed, two or more sets of readings were taken. The western pivot has been the higher throughout the year, and the error has therefore been regarded as *positive*. The instrument has been lifted and reversed about once a week by means of an apparatus for that purpose, and the collimation error determined by comparing the middle wire in both positions of the axis of rotation with the corresponding wire of a 2-inch transit instrument on a pier in a small house a little north of the transit room. These comparisons were always made near the horizontal wires, the transit system of the collimator being illuminated by a small lamp on a shelf near its eyepiece. As there is no micrometer in connection with the 3-inch transit instrument, the distance of the middle wire from that of the collimator was estimated for each position of the axis of rotation in terms of the diameter of the middle wire of the collimator. Half the total displacement reduced to seconds of arc from the known diameter of the collimator wire was regarded as the collimation error. Throughout the year the axis of collimation lay between wires C and D, and the collimation error has therefore been regarded as *positive*. The corrections for the upper transit have therefore been + or —, according as the clamp was east or west. On every occasion when the instrument was reversed star transits were observed in both positions of the rotation axis, and by allowing for chronometer rate it has been found that the estimations for collimation error were quite as reliable as the results which might be obtained by the application of the micrometer to so small an instrument. The azimuth error has been determined either from opposite culminations of β Hydri and β Chamæleontis, from contacts and bisections of σ Octantis at the middle wire and an approximate chronometer correction, from transits of a high and a low star north of the zenith, or of a star in high south declination and one near the equator. The azimuth stars have been taken either from the Greenwich *Nautical Almanac* or from the American *Ephemeris*. I have again to acknowledge the valuable aid rendered by the latter publication in the department of circumpolar stars.

During the year 1890 the western pivot of the transit instrument has been invariably too far south, and the azimuth error has therefore been considered *negative*. No adjustment of the instrument for azimuth has been made since June 24, 1887. The following table will therefore afford an idea of the steadiness of this adjustment since that date:—

Period.	Number of Azimuth Determinations.	Mean of all the Determinations.	Extreme Azimuth Determinations.	
		″	″	″
June 24 to Dec. 31, 1887...	41	—6.97	—10.46	—4.39
Year 1888	88	—5.37	—13.05	—0.28
Year 1889	105	—8.09	—14.94	—1.45
Year 1890	133	—9.32	—13.96	—3.92

Very carefully constructed MS. tables have been employed for the reductions for level, collimation, and azimuth. For all stars north of the zenith a table has been used whose arguments are each degree of declination from — 3[illegible] to + 56°, and the values of the level, collimation, and azimuth errors for every second of arc from 1 to 15. The stars for time determinations, irrespective of the azimuth stars, have been taken from those with a declination less than 40° in the Clock Star Lists of the Greenwich *Nautical Almanac* and the American *Ephemeris*. The apparent right ascensions of both clock and azimuth stars have been corrected for daily aberration, but no systematic corrections for equinox have been applied. When the stars have been found in both publications the right ascensions of the former have been adopted. It may here be added that all time observations out of the meridian in connection with lunar occultations, phenomena of Jupiter's satellites, planets, comets, etc., have been made with the sidereal chronometer Parkinson and Frodsham, whose corrected indications have been converted into local mean times by employing the sidereal time at Greenwich mean noon of the *Nautical Almanac*, corrected by the quantity — 1m. 39.12s. These conversions have been checked by the use of the mean time of

the preceding transit of the First Point of Aries corrected by the quantity + 1m. 38.84s. In the following table will be found a statement of the errors of the transit instrument and the errors and rates of the sidereal chronometer for the year 1890. The instrumental errors in square brackets are simply interpolated or assumed. The figures in the second column both of this table and of the tables in previous reports indicate the number of clock stars observed whose declination did not exceed 40°, and the letters E and W after the names of the azimuth stars in the seventh column show the position of the clamp when such stars were observed for azimuth. Finally, it will be seen that the rate of the chronometer during the past year has not been so steady as in previous years. The unsteadiness is doubtless due to the wear of the mechanism, the instrument having been in continuous use ever since the year 1864. The eight-day mean time chronometer—John Poole, No. 2962—was placed in the hands of Messrs. Allerding of Sydney in December, 1890, in order to have its rate changed for sidereal time. This chronometer, whose rate is much better than that of Parkinson and Frodsham, will be employed in connection with the transit instrument during the year 1891.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits
1890.			"	"	"		H. M.	M. S.	S.	S.
Jan. 9	7	E W.	1.3	3.4	5.67	η Tauri, γ Hydri, W.	3 28	5 15.52		
	6	W.	1.0	[3.4]	3.92	30 Monocerotis, θ Chamæ.	9 19	5 17.05	0.262	0.26
„ 20	3	W.	2.3	[3.2]	[4.3]		5 49	6 25.25	0.262	0.26
Mar. 14	6	W.E.	1.8	2.4	6.45	ξ Gemin., ζ Mensæ, W.	6 40	11 43.43	0.250	0.19
„ 15	1	E.	2.0	[2.4]	[7.1]		7 56	11 48.34	0.194	0.21
„ 16	4	E.	1.7	[2.4]	7.76	γ^2 Piscis Vol., δ Gemin.	7 11	11 53.72	0.231	0.24
„ 17	2	E.	2.4	[2.4]	[7.8]		7 4	11 59 52	0.243	0.24
„ 25	7	E.W	0.9	2.4	8.35	30 Monoc, θ Chamæ., W.	8 11	12 46.03	0.241	0.22
„ 29	4	W.	2.7	[2.7]	[8.4]		8 42	13 5.85	0.205	0.23
„ 31	3	W.	2.3	[2.9]	8.44	o Leonis, ζ Chamæleontis	9 42	13 17.52	0.238	0.23
April 1	9	W.E	2.2	3.0	7.74 9.43	Canopus, γ Gemin., W. 30 Mono., θ Chamæ., E.	8 35	13 22 71	0.227	0.23
„ 4	4	E.	2.7	[3.2]	7.22	30 Mono., θ Chamæ.	8 15	13 38.93	0.226	0.22
„ 7	7	E.W.	3.6	3.4	7.39 8.57	30 Mono., θ Chamæ, E. θ Hydræ, β Argûs, W.	8 44	13 55.04	0 222	0.23
„ 11	5	W.	3.8	[3.3]	8.14	30 Mono., θ Chamæleontis	8 34	14 18 52	0.245	0.20
„ 12	3	W.	3.8	[3.3]	[8.3]		8 21	14 23.14	0.194	0.20
„ 18	4	W.	3.8	[3.1]	9 37	θ Hydræ, β Argûs	9 41	14 53.64	0.210	0.22
„ 23	6	W.E.	4.4	3.0	7.01	β Chamæ., β Hydri, W.	11 21	15 21.78	0.231	0.25
„ 24	3	E.	3.8	[3.0]	[8 0]		10 16	15 27.48	0.249	0 24
„ 26	5	E.	4.1	[2.9]	9.88	o Leonis, ζ Chamæleontis	10 1	15 38.28	0.226	0.23
„ 27	5	E.	4.5	[2.8]	8.76	δ^2 Chamæ., *d* Leonis	11 14	15 44.02	0.228	0.23
„ 29	2	E.	4.5	[2.7]	[8.9]		9 41	15 55.16	0.240	0.23
May 4	3	E.	4.1	[2.5]	[9.5]		10 26	16 19.47	0.201	0.20
„ 7	8	E W.	3.1	2.4	8.11 10.47	o Leonis, ζ Chamœ , E. δ^2 Chamæ., χ Leonis, W.	10 47	16 34.47	0.201	0 20

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. ÷	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1890.			"	"	"		H. M.	M. S.	S.	S.
May 8	5	W.	3.9	[2.4]	10.83 11.20	ρ Leonis, η. Argûs d Leonis, η Octantis	11 13	16 39.24	0.195	0.20
„ 10	3	W.	5.8	[2.3]	[10.3]		11 32	16 49.11	0.204	0 22
„ 12	1	W.	3 2	[2.2]	[9.5]		13 14	17 0.86	0.236	0.25
„ 13	8	W.E.	4 8	2.2	9.02	d Leonis, η Octantis, E.	10 32	17 6.28	0.255	0.26
„ 14	4	E.	3.6	[2.5]	[10.1]		10 34	17 12.61	0.263	0.25
„ 15	5	E.	2.5	[2.8]	[11.2]		10 49	17 18.59	0 247	0.20
„ 16	4	E.	3.3	[3.1]	12.26	ηOctantis, τ Leonis	11 39	17 22.61	0.162	0 18
„ 19	4	E.	2.3	[4 1]	12.51	δ Ophiuchi. γ Apodis	16 40	17 40.14	0.228	0.22
„ 20	6	E.W.	3.0	4.4	9.82	η Octantis, τ Leonis E.	11 55	17 44.08	0.205	0.17
„ 21	3	W.	2.1	[4 0]	[9.8]		12 37	17 47.39	0.184	0 18
„ 22	3	W.	2.8	[3.6]	[9.7		11 33	17 52.37	0.217	0 18
„ 23	2	W.	2.9	[3.2]	[9.6]		12 25	17 55.84	0.141	0.19
„ 24	3	W.	3 1	[2 8]	9 55	ι Argûs, α Hydræ	9 48	18 0.87	0.233	0.22
„ 25	8	W.E.	3.3	2 4	10.02 13.13	η Argûs, l Leonis, W. η Octantis, τ Leonis, E.	11 11	18 5.87	0 197	0 20
„ 29	7	E.	4.4	[2.5]	13 96	o Leonis, ζ Chamæleontis	11 14	18 27.35	0.224	0.19
„ 30	4	E.	3.6	[2.6]	12.29	o Leonis, ζ Chamæleontis	10 8	18 31.57	0.184	0.19
June 3	4	E.	3.5	[2.7]	8.58	κ Octantis, ζ Virginis	13 31	18 53.10	0.217	0.21
„ 14	8	E.W.	3.5	3.0	8.00	β Chamæ., β Hydri, W.	12 6	19 41.79	0.185	0.20
„ 15	5	W.	4.4	[2 9]	7.83	β Chamæ., β Hydri	12 57	19 46.74	0.200	0.24
„ 16	3	W.	3.5	[2.9]	[8.4]		12 30	19 53.19	0.274	0 26
„ 18	6	W.E.	3.7	2 8	9 65	δ Virginis, δ Muscæ, W.	13 11	20 4.60	0.234	0.22
„ 19	2	E.	3 1	[2 7]	[10.1]		13 3	20 9.50	0.205	0.20
„ 20	4	E.	2.5	[2.6]	10.53	κ Octantis, ζ Virginis	13 42	20 14.27	0.194	0.19
„ 22	3	E.	1.8	[2.5]	[8.9]		12 56	20 22.32	0.170	0.20

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level,	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			″	″	″		H. M.	M. S.	S.	S.
June 23	5	E.	2.6	[2.4]	8 02	β Chamæleontis, β Hydri	12 31	20 27.40	0.215	0.21
,, 30	8	E.W.	1.6	1.8	10.39	ρ Octantis, α Serpentis, E.	15 58	21 1.67	0.200	0.24
July 1	3	W.	2.1	[1.8]	[9.3]		14 14	21 7.21	0.249	0.25
,, 2	3	W.	2.1	[1.8]	8.20	δ Muscæ, θ Virginis	13 21	21 13.12	0 256	0.25
,, 7	2	W.	2.2	[1.9]	[8 8]		16 18	21 37.34	0.198	0.21
,, 10	7	W E.	2.6	2 0	9.05	δ Muscæ, ε Virginis, W.	13 23	21 51.84	0.210	0.20
,, 12	5	E.	2.2	[1 8]	10.08	τ Virginis, δ Octantis	14 39	22 1.32	0.192	0 11
,, 13	2	E.	1.9	[1.8]	[10.8]		15 5	22 3.07	0.072	0.14
,, 14	5	E.	2.8	[1.7]	11.59	δ Virginis, δ Muscæ	12 46	22 7.46	0.203	0.17
,, 15	5	E	1.6	[1.6]	11.74	κ Octantis, ζ Virginis	13 39	22 10.66	0.129	0.14
,, 16	4	E.	2.8	[1.5]	[11.5]		14 30	22 14.50	0 155	0.16
,, 17	6	E.W.	2 8	1.4	11.19	δ[1] Apodis, β Herculis, W.	16 19	22 18.62	0.160	0.16
,, 20	2	W.	2.4	[1.8]	8.00	κ Octantis, ζ Virginis	13 47	22 30.03	0.164	0.17
,, 21	3	W.	3.2	[1.9]	8.09	κ Octantis, ζ Virginis	13 53	22 34.14	0.171	0.17
,, 22	10	W.E.	2.8	2.0	7.61 10.85	κ Octantis, ζ Virg., W. ρ Octantis, ε Serpen., E.	14 28	22 38.44	0.175	0.19
,, 23	6	E.	3.0	[2.2]	9.13	σ Octantis	18 21	22 43.92	0.197	0.20
,, 24	5	E.	2.7	[2.5]	10.94 10.34	π Hydræ, δ Octantis α Tri. Aust., κ Ophiuchi	15 55	22 48.31	0.204	0.20
,, 28	4	E.	2.9	[3.4]	[10.4]		16 5	23 7.70	0.202	0.21
,, 29	8	E.W.	2.4 10.9	3.6	10.25	δ Ophiuchi, γ Apodis, E.	16 3	23 12.81	0.213	0.22
Aug. 1	6	W.	11.4	[3.0]	9.15	ε Serpentis, δ[1] Apodis	15 53	23 28.46	0.218	0 18
,, 3	2	W.	11.3	[2.6]	[10.3]		17 42	23 36.76	0.167	0.15
,, 4	8	W.E.	11.3	2.4	12.23 9.15 11.39	ρ Bootis, α[2] Centauri, W. α Serp., δ[1] Apodis., W. α Tri. Aust., κ Oph., E.	16 3	23 40.08	0.149	0.17

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			−	− −	—		H. M.	M. S.	S.	S.
Aug. 5	2	E.	10.9″	[2.6]″	[10.6]″		15 6	23 44.47	0.191	0.20
„ 8	5	E.	11.6	[3.3]	11.85 7.77	α^2 Centauri, ϵ Bootis δ^1 Apodis, δ Ophiuchi	14 52	24 1.23	0.234	0.19
„ 10	3	E.	10.4	[3.8]	9.08	ζ Ophiuchi, α Tri. Aust.	16 48	24 10.20	0.180	0.17
„ 11	6	E.W.	11.1 1.9 6.9	4.0	8.68	ρ Octantis, α Serpentis, E.	16 1	24 14.21	0.172	0.18
„ 13	4	W.	11.9	[3.4]	8.44	ρ Octantis, α Serpentis	15 56	24 22.84	0.180	0.21
„ 14	3	W.	10.4	[3.1]	8.59	ρ Octantis, α Serpentis	15 51	24 28.12	0.221	0.21
„ 15	4	W.	10.6	[2.8]	9.27	ρ Octantis, α Serpentis	15 44	24 32.78	0.195	0.16
„ 16	4	W.	10.1	[2.5]	[8.7]		17 3	24 36.06	0.130	0.17
„ 17	8	W.E.	11.7	2.2	8.07 10.41	ρ Octantis, α Serp., W. α Tri. Aust., κ Oph., E.	16 26	24 41.03	0.213	0.21
„ 18	3	E.	10.7	[2.6]	[9.4]		15 51	24 45.71	0.200	0.19
„ 19	5	E.	11.9	[2.9]	10.74	α Tri. Aust., κ Ophiuchi	16 24	24 50.86	0.189	0.20
„ 21	3	E.	12.1	[3.6]	10.53	θ Ophiuchi, β Draconis	16 24	25 0.99	0.222	0.23
„ 22	6	E.W.	12.2	4.0	13.21	ϵ Serpentis, δ^1 Apodis, W.	15 55	25 6.65	0.241	0.22
„ 23	7	W.	11.1	[3.8]	12.77	ϵ Serpentis, δ^1 Apodis	16 39	25 11.51	0.197	0.20
„ 24	2	W.	11.5	[3.5]	[12.1]		17 24	25 16.64	0.207	0.23
„ 25	3	W.	13.2	[3.3]	[11.4]		17 35	25 22.65	0.249	0.26
„ 26	4	W.	12.0	[3.1]	10.64	σ Octantis	19 5	25 29.70	0.277	0.29
„ 28	6	W.E.	12.9	2.6	9.15	ϵ Serpentis, δ^1 Apodis, W.	16 24	25 43.46	0.304	0.28
„ 29	2	E.	11.6	[2.6]	[10.3]		16 30	25 50.10	0.276	0.30
„ 31	4	E.	13.2	[2.7]	12.44	σ Octantis	18 45	26 7.17	0.340	0.31
Sept. 1	3	E.	13.6	[2.8]	8.73	σ Octantis	19 1	26 14.46	0.300	0.30
„ 2	1	E.	15.0	[2.8]	[9.2]		20 38	26 22.12	0.299	0.27

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. —	Collimation. —	Azimuth. —	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			″	″	″		H. M.	M. S.	S.	S.
Sept. 4	2	E.	12.4	[2.8]	10.23	σ Octantis	18 54	26 32.55	0.226	0.22
„ 8	7	E.W.	12.9	3.0	7.70	β Aquarii, λ¹ Octantis, W.	18 53	26 53.32	0.216	0.17
„ 9	4	W.	12.7	[3.0]	8.90 10.71	θ Ophiuchi, β Draconis σ Octantis	17 32	26 56.96	0.161	0.14
„ 10	3	W.	13.6	[3.0]	9.20	α Aquarii, υ Octantis	21 24	27 0.11	0.113	0.17
„ 11	3	W.	13.0	[3.0]	10.59	σ Octantis	19 17	27 5.36	0.235	0.24
„ 15	6	W.E.	14.3	3.0	8.74	σ Octantis, E.	19 2	27 29.66	0.254	0.28
„ 16	3	E.	14.8	[3.1]	[9.4]		19 31	27 36.56	0.282	0.28
„ 17	2	E.	14.9	[3.2]	[10.1]		20 37	27 43.40	0.273	0.26
„ 18	4	E.	14.4	[3.2]	10.79	ε Delphini, β Pavonis	20 55	27 49.59	0.255	0.26
„ 19	4	E.	15.5 1.4	[3.3]	9.46	σ Octantis	18 16	27 55.09	0.258	0.25
„ 20	6	E.W.	1.4	3.4	11.29	γ Aquilæ, ε Pavonis, W.	19 40	28 1.47	0.251	0.25
„ 23	3	W.	2.5	[3.0]	10.16	σ Octantis	18 11	28 19.24	0.252	0.22
„ 26	3	W.	1.9	[2.5]	8.92	γ Aquilæ, ε Pavonis	19 59	28 33.44	0.192	0.18
„ 27	4	W.E.	2.0	2.4	10.50	ε Delphini, β Pavonis, E.	20 6	28 37.79	0.180	0.21
„ 28	4	E.	1.2	[2.3]	9.41	Altair, ε Pavonis	19 32	28 43.19	0.231	0.22
„ 29	3	E.	1.2	[2.3]	9.04	σ Octantis	19 45	28 48.19	0.206	0.24
„ 30	2	E.	1.8	[2.2]	11.24	σ Octantis	19 10	28 54.75	0.280	0.29
Oct. 2	3	E.	1.5	[2.1]	[9.6]		19 50	29 9.31	0.299	0.30
„ 3	3	E.	1.7	[2.1]	8.71	γ Aquilæ, ε Pavonis	20 5	29 16.44	0.294	0.30
„ 4	5	E.W.	2.8	2.0	7.02	Altair, ε Pavonis, E.	21 32	29 24.41	0.313	0.28
„ 5	3	W.	3.8	[1.8]	[7.2]		20 35	29 30.20	0.251	0.25
„ 6	4	W.	4.5	[1.7]	7.39	Altair, ε Pavonis	20 24	29 36.06	0.246	0.24
„ 8	3	W.	3.8	[1.3]	10.71	α Aquarii, υ Octantis	22 48	29 47.00	0.217	0.21
„ 9	3	W.	2.4	[1.1]	7.56	θ Aquilæ, α Pavonis	20 34	29 51.42	0.203	0.22

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
Oct. 12	5	W.E.	2.4	0.6	7.70	Altair, ϵ Pavonis, W.	20 28	30 10.42	0.264	0.26
„ 13	3	E.	2 6	[0·7]	7.91	α^2 Capricorni, α Pavonis	20 35	30 16.81	0.265	0.26
„ 14	3	E.	3.7	[0.8]	[7.9]		21 13	30 23.25	0.262	0.28
„ 16	2	E.	2.2	[1.0]	[8.0]		21 54	30 38.46	0.312	0.32
„ 17	4	E.	2.1	[1.1]	7.99	β Aquarii, λ^1 Octantis	21 44	30 46.23	0.326	0.29
„ 19	4	E.	4.2	[1.3]	8.42	β Aquarii, λ^1 Octantis	21 35	30 57.21	0.230	0.26
„ 22	5	E.W.	4.4	1.6	7.68	β Aquarii, λ^1 Octantis, W.	21 2	31 19.76	0.316	0.32
„ 23	3	W.	3.6	[1.6]	9.89	α Aquarii, υ Octantis	22 20	31 27.81	0.318	0.33
„ 24	6	W.	4.3	[1.5]	9.95	η Aquarii, β Octantis	0 41	31 36.68	0.337	0.34
„ 25	2	W.	4.1	[1.5]	[8.8]		22 37	31 44.08	0.337	0.29
„ 26	3	W.	2.1	[1.5]	[7.7]		22 12	31 49.83	0.244	0.27
„ 27	4	W.	3.8	[1.4]	6.56	β Aquarii, λ^1 Octantis	22 27	31 57.13	0.301	0.29
„ 28	5	W.E.	3.0	1.4	8.68	β Aquarii, λ^1 Octantis, W.	22 16	32 3.61	0.272	0.29
„ 29	4	E.	3.1	[1.5]	9.31	η Aquarii, β Octantis	22 59	32 11.42	0.316	0.30
„ 31	3	E.	4.1	[1.8]	9.34	η Aquarii, β Octantis	22 51	32 24.49	0.273	0.27
Nov. 1	2	E.	3.5	[1.9]	[9.0]		22 26	32 30.99	0.276	0.27
„ 5	3	E.	3.7	[2.5]	7.86	η Aquarii, β Octantis	23 7	32 55.54	0.254	0.27
„ 6	7	E.W.	4.2	2.6	{ 7.72 8.09	α Aquarii, υ Octantis, E. η Aquarii, β Octant., E. }	23 26	33 2.15	0.274	0.25
„ 7	4	W.	5.3	[2.4]	[7.8]		23 14	33 7.32	0.217	0.23
„ 10	4	W.	4.8	[2.0]	7.41	ι Piscium, γ^1 Octantis	23 47	33 26.54	0.265	0.27
„ 14	7	W.E.	3.6	1.4	8.29	η Aquarii, β Octantis, W.	23 53	33 53.81	0.284	0.24
„ 15	6	E.	4.9	[1.3]	{ 8.37 8.71	η Aquarii, β Octantis β Chamœ., β Hydri }	23 59	33 59.46	0.234	0.24
„ 22	2	E.	3.1	[0.7]	9.66	ϵ Piscium, κ Tucanæ	1 49	34 46.59	0.272	0.29
„ 23	6	E.W.	3.3	0.6	{ 6.93 8.50	π Piscium, Achernar, E. ξ^1 Ceti, δ Hydri, W. }	2 28	34 53 85	0.295	0.30

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. —	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	s.	s.
Nov. 24	4	W.	3.1	[0.7]	6.73	β Chamæleontis, β Hydri	0 7	35 0.60	0.312	0 32
„ 27	4	W.	4.1	[0.9]	[8.9]		0 23	35 25 03	0.338	0.30
„ 28	4	W.	4.1	[0.9]	[9.7]		0 24	35 31.89	0.286	0 30
„ 29	8	W.E.	4.5	1.0	10.39	β Chamæ., β Hydri, E.	0 37	35 39 72	0.323	0.32
Dec. 3	5	E.	4.1	[1.8]	7.59	β Chamæleontis, β Hydri	1 1	36 7.71	0.290	0.28
„ 5	4	E.	4.4	[2.2]	9.47	β Hydri, δ Piscium	1 24	36 21.29	0.281	0.28
„ 7	7	E.W.	6.1	2.6	8.17 10.88	β Chamæ., β Hydri, E. ε Piscium, κ Tucanæ, W.	1 28	36 34.30	0.271	0.26
„ 10	5	W.	4.4	[2.3]	8.07	Achernar, ν Piscium	2 10	36 52 57	0.251	0.26
„ 14	3	W.	4.7	[1.9]	9.28	β Hydri, δ Piscium	1 21	37 18 99	0 278	0.30
„ 17	8	W.E.	3.9	1.6	9.88	δ Hydri, δ Ceti, E.	2 40	37 42.94	0.327	0.31
„ 18	4	E.	3.1	[1.7]	12.10	ε Piscium, κ Tucanæ	1 55	37 48.95	0.259	0.28
„ 19	5	E.	5.0	[1.9]	12.83 9.44	κ Tucanæ, η Piscium π Piscium, Achernar	1 53	37 57.68	0.364	0.31
„ 20	6	E.	5.1	[2.0]	6.21	Achernar, ο Piscium	2 8	38 5.65	0.329	0 35
„ 23	7	E.W.	6.3	2.4	11.97 10.87 9.12	κ Tucanæ, η Piscium, E. Achernar, ο Piscium, E. δ Hydri, δ Ceti, W.	2 34	38 32.40	0.369	0.34
„ 24	5	W.	6.8	[2.2]	7.89	δ Hydri, δ Ceti	2 57	38 41.02	0.354	0.35
„ 25	6	W.	6.1	[2.1]	8.64	δ Hydri, δ Ceti	3 9	38 49.51	0.351	0.35
„ 30	8	W.E.	6.9	1.2	7.75 8.78	δ Hydri, δ Ceti, W. ι Hydri, f Tauri, E.	3 16	39 29.15	0.330	

NOTES.

A remarkable change occurred in the chronometer rate on July 12-13.

On July 29 the transit-frame during the operation of reversing received a perpendicular blow which changed the level error considerably for clamp W. No sensible change was produced in the azimuth.

On reversing the instrument on Aug. 11 the level error was found to be only +1.9″ and it gradually changed to + 6.9″. The discrepancies were obviously due to particles of dust falling into the bearings. After thoroughly cleaning the pivots and bearings the level error recovered its former value.

The eastern pivot was raised during the observations of September 19.

Extra-Meridian Work.

The early part of the year was characterized by cloudy weather. The following is a *resumé* of the work done in this department:—

Occultations of Stars by the Moon.—The occultations of twenty-four stars were observed, chiefly with the 8-inch equatorial, comprising twenty-four disappearances and three reappearances. Sixteen of the stars have been identified. The results have been forwarded to the *Astronomische Nachrichten*. The total number of occultation phases observed here during the period 1864-1890 is 433—namely, 417 disappearances and 16 reappearances. The disproportion is due to the circumstance that prediction-calculations of these phenomena have seldom been made.

Phenomena of Jupiter's Satellites.—These have been observed chiefly with the 8-inch equatorial, and are classified thus:—Transit-ingress, I.3, II.2, III.1, IV.1; Transit-egress, I.5, III.1, IV.1. Occultation-disappearances, I.4, II.2, IV.1; Occultation-reappearance, I.1. Eclipse-disappearances, I.1, III.1, IV.2; Eclipse-reappearances, I.7, II.4, III.4. These results have been forwarded to the Royal Astronomical Society.

Eclipse of the Sun, December 12, 1890.—This was observed with the 4½-inch equatorial. The first contact of the partial phase was lost in consequence of cloud, but the last contact was well observed.

Minor Planets.—Four minor planets were observed with the filar-micrometer of the 8-inch equatorial, as follows:—Ceres (1), on May 13, 15, 19, 20, 21, 22, 23, 24, 25, 29, comprising 76 comparisons and 3 comparison stars; Juno (3), on May 19, 20, 22, 25, comprising 34 comparisons and 2 comparison stars; Ariadne (43), on July 21, 22, 23, comprising 30 comparisons and 2 comparison stars; and Undina (92), on September 8, 9, 10, comprising 38 comparisons and 2 comparison stars. All the observations have been completely reduced for refraction and parallax and sent to the *Astronomische Nachrichten*.

Comets.—The following comets were observed with the square bar-micrometer on the 8-inch equatorial:—Comet Denning, on October 4, comprising 3 comparisons and 1 comparison star; and Comet d'Arrest, on October 12, 13, 14, 16, 17, November 1, 5, 6, comprising 99 comparisons and 8 comparison stars. Both these comets were excessively faint and difficult to observe. The results have been sent to the *Astronomische Nachrichten.*

Double Stars.—The following interesting binaries have been observed with the 8-inch equatorial:—*p* Eridani, Lalande 4219, γ Centauri, *h* 4634, α Centauri, Brisbane 5784, and γ Coronæ Australis. All the measures of double stars taken in 1889 and 1890 have recently been forwarded to the Royal Astronomical Society. The distance of the last mentioned binary is certainly much greater than that given by Mr. Powell's orbit in the *Monthly Notices* for March, 1890.

Variable Stars.—Comparisons have been continued of the well-known variables η Argûs and *R* Carinæ. The former star has not sensibly varied in its lustre since the announcement of its sudden increase of magnitude between April, 1887, and May, 1888. I propose shortly to publish a careful revision of the Windsor observations from 1854 to 1890. A very satisfactory determination of the maximum of the latter star was made in April, 1890, and the results of the comparisons of this star, extending from November, 1886, to June, 1890, appeared in the *R.A.S. Monthly Notices* for November, 1890. The magnitude at maximum varies considerably. This variable has been closely watched at this Observatory from 1880 to 1890, and ten maxima have been determined.

Meteorological Observations.

The usual 9h. a.m. observations have been kept up with great regularity during the year. They comprise observations of the barometer, maximum and minimum temperature of the air and evaporation, maximum solar radiation, and minimum radiation on the grass, rainfall and evaporation, direction of the wind, and cloud extent,

as in former years. The results for 1886, 1887, 1888, 1889, and 1890 are under preparation for publication. Since 1862 the rainfall results have been forwarded annually to the Government Astronomer for incorporation with similar results from the Government Meteorological Stations. The self-registering tide-gauge referred to in the last annual report as having been established on the South Creek has since been removed in consequence of the frequent freshes. The meteorological observations now extend over a period of twenty-eight years.

Publications.

The following is a list of the papers published by the author in journals and transactions of scientific societies since the report for 1889:—

OBSERVATIONS OF COMETS 1889 IV. (DAVIDSON) AND 1889 V. (BROOKS).—These comprise observations of the former comet (continued from *Ast. Nachrichten*, No. 2924) from July 27 to August 15, 1889, and observations of the latter on October 25, 28, 1889.—*Astronomische Nachrichten*, Band cxxiii., No. 2952, p. 409.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES IN THE YEAR 1889. — *R.A.S. Monthly Notices*, vol. L., p. 335.

OBSERVATIONS OF THE MINOR PLANETS PALLAS, JUNO, HEBE, AND FLORA.—*Ast. Nach.*, Band cxxiv., No. 2961, p. 141. These observations were made with the 8-inch equatorial. (See Reports for 1888 and 1889, pp. 20 and 17 respectively.)

OBSERVATIONS OF LUNAR OCCULTATIONS OF STARS IN 1889.—*Ast. Nach.*, Band cxxiv., No. 2963, p. 181. (See Report for 1889, p. 17.)

ASTRONOMICAL AND METEOROLOGICAL WORKERS IN N.S. WALES.—*Observatory*, vol. XIII., p. 211.

DETERMINATION OF POSITION OF SUPPOSED VARIABLE IN R.A., 12h. 18m., DECLIN.—48° 43′ (1875.0).—*Ast. Nach.*, Band cxxv., No. 2979, p. 41.

OBSERVATIONS OF THE MAGNITUDES OF *R* CARINÆ, November, 1886, to June, 1890. — *R.A.S. Monthly Notices*, vol. LI., p. 46.

The following communication was omitted in the Report for 1889:—

COMET NOMENCLATURE. — *Observatory*, vol. XII., p. 183.

The Library.

At the close of this Report will be found an acknowledgment of all presents received during the year 1890, for which the author tenders his best thanks.

Conclusion.

All the astronomical and nearly all the meteorological observations during the past year have been made by the proprietor himself. He has also executed the greater and more difficult part of the reductions. The work for the year 1891 will be similar to that for 1890. Occultations and southern comets will be observed as far as possible, and the meteorological work continued as usual.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1890.

[Note.—The Names of the Donors are printed in Italics.]

Results of Rain, River, and Evaporation Observations in N.S. Wales 1889, by H. C. Russell, F.R.S., &c., pp. 183, with diagrams. Two copies.

Results of Meteorological Observations in N. S. Wales, 1888, by H. C. Russell, F.R.S., &c., pp. 142, with diagrams.

The Government Astronomer for N. S. Wales.

Second Melbourne General Catalogue of 1211 Stars for 1880, by R. L. J. Ellery, F.R.S., &c., pp. 63.

Monthly Records of Results of Observations in Meteorology, Terrestrial Magnetism, &c., at the Melbourne Observatory, with Abstracts from Various Localities in Victoria. Monthly parts from October, 1889, to July, 1890.

The Government Astronomer for Victoria.

Rainfall Results at South Australian Stations, in monthly parts, October, 1889, to August, 1890.

Rainfall in South Australia and Northern Territory during 1887, by C. Todd, C.M.G., &c.

Report on Telegraphic Determination of Australian Longitudes.

The Government Astronomer for S. Australia.

Weather Reports for Hobart, Tasmania. Monthly sheets, January, 1890, to October, 1890.

Report of the Meteorological Observer, Tasmania, for 1889.

The Government Meteorological Observer, Tasmania.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, Vol. V., Part II.

The Society.

The Surveyor for January 7, February 4, March 4, April 1, May 6, June 3, July 1, August 5, September 2, October 7, November 4, December 2, 1890.

N.S. Wales Association of Surveyors.

Report of the Meteorological Council of the Royal Society for the Year ended March 31, 1889.

Meteorological Observations at the Foreign and Colonial Stations of the Royal Engineers and the Army Medical Department, 1852-86, pp. 261.

Quarterly Weather Report, Part I., January—March, 1880.
Weekly Weather Reports, September 9, 1889, to May 17, 1890.
Quarterly Summary of Weekly Weather Reports, 1889, and its Fourth Quarter; and of 1890, First Quarter, January—March.
Monthly Summaries from April to September, 1888, and from May, 1889, to February, 1890.
Weekly Weather Report, 1889, Vol. II., Appendices II., III., IV.
Quarterly Summary, July—September, 1889.

The Meteorological Office, London.

Report of the Kew Observatory for the year ended October 31, 1889, pp. 24.

The Kew Observatory.

Greenwich Ten-Year Catalogue of 4059 Stars for 1880.

The Astronomer Royal for England.

Astronomical Observations at the Observatory of Cambridge, Vol. XXII., for 1866, 1867, 1868, 1869, pp. 366, with Appendices.

The Cambridge Observatory, England.

Photographs of the Corona during the Total Eclipse of the Sun, January 1, 1889, by D. P. Todd.
The Solar Corona discussed by Spherical Harmonics, by Professor F. H. Bigelow.
Annual Reports of the Smithsonian Institution for years ending June 30, 1886 and 1887, Parts I., pp. 878 and 785.

The Smithsonian Institution, U.S.A.

Catalogue of Stars, by Professor M. Yarnall, 3rd edition, 10964 Stars for 1860, revised by Professor Frisby, pp. 302.
Report of the U.S.N. Observatory for year ending June 30, 1889.

The U.S.N. Observatory, Washington.

American Ephemeris and Nautical Almanac for 1892, pp. 521.

The Office of the American Ephemeris, Washington.

Reports on the Observations of the Total Eclipse of the Sun, January 1, 1889, published by the Lick Observatory, pp. 210, with plates.

The Lick Trustees.

Annals of Harvard College Observatory, Vol. XVIII., No. X.; Meridian Circle Observations of Stars near the South Pole, pp. 23.
Henry Draper Memorial, 4th Annual Report of the Photographic Study of Stellar Spectra at Harvard College Observatory, pp. 9, with plate.

Harvard College Observatory.

Publications of the Leander McCormick Observatory of the University of Virginia, Vol. I., Part IV., Double Stars, 1885-86, pp. 97.

Leander McCormick Observatory, U.S.A.

Publications of Carleton College Observatory, U.S.A., Catalogue of 644 Comparison Stars for 1890, pp. 55, with plates.

Carleton College Observatory, U.S.A.

Publications of the Cincinnati Observatory, Double Stars, 1882-86, pp. 70.

Cincinnati Observatory, U.S.A.

Publications of the Washburn Observatory, Vol. VI., Part I., Observations with the Meridian Circle; Part II., Observations of Double Stars, pp. 140, with plate.

Washburn Observatory, U.S.A.

History and Work of the Warner Observatory, Rochester, New York, Vol. I., 1883-86, pp. 70, with plates.

The Warner Observatory.

Pennsylvania State Weather Service. Monthly Weather Review for June, July, and September, 1890, with map.
Electricity in Warfare, by Lieut. B. A. Fiske, U.S.N., pp. 21.
Bulletin of the Franklin Institute, September and October, 1890.
Precious Stones, by G. F. Kunz, pp. 34.
The Metallurgical Arts at the Paris Exhibition, by F. Lynwood Garrison, pp. 114, with plates.
On the Use of Galvanised Iron for Artesian Wells, &c., by R. Haines, pp. 9.
The Use of the Diamond Drill of the Ancient Egyptians.

The Franklin Institute, Philadelphia.

Monthly Weather Review of the Meteorological Service of the Dominion of Canada, September, 1889, to July, 1890.
Report of the Service for 1886.

The Meteorological Office, Toronto.

Influence de l'Altitude sur la Marche Diurne du Barometre, par Ch. André, pp. 147, with diagrams.
Description du Service Horaire de la Ville de Lyon, par Ch. André, pp. 30, with plates.

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Anhang zu den Zonenbeobachtungen der Sterne zwischen 55° und 65° nordlicher declination, zu Helsingfors und Gotha, pp. 30. Two copies.
Tafel für das dritte Glied der Præcession, von H. Kloock, pp. 34. Two copies.

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Vade-Mecum de l'Astronome, par J. C. Houzeau, pp. 1144, Bruxelles, 1882.

Annales de l'Observatoire Royal de Bruxelles. Tome IV., Obs. Ast. en 1879-81. Tome V., 3 ieme Fascicule. Tome VI., Cat. de 10792 Etoiles pour 1865.0, par E. Quetelet, pp. 619.
Exposition Critique de la Méthode de Wronski pour la resolution des Problèmes de Mécanique Céleste, par Ch. Lagrange, Premiere Partie, Bruxelles, 1882, pp. 70.
Annuaire de l'Observatoire Royal de Bruxelles pour 1882, pp. 367; 1883, pp. 210; 1884, pp. 270; 1885, pp. 374; 1886, pp. 314; 1887, pp. 577; 1888, pp. 592.

The Royal Observatory, Brussels.

Considerazioni sul moto rotatorio del pianeta Venere, del M. E. G. V. Schiaparelli, in 5 Parts, pp. 12, 15, 13, 12, and 20.
Determinazione della Differenza di Longitudine tra gli Osservatorii Astronomici di Milano e di Torino, pp. 60.

The Observatory, Brera, Milan.

Dorpater Meteorologischen Beobachtungen, Jan.—Dec., 1889.
Witterungs-Beobachtungen für Luftdruck, Temperatur, &c., 1881-3.
Fortsetzung der Neuen Untersuchungen über die Bessel'sche Formel und deren Verwendung in der Meteorologie, von Dr. K. Weihrauch, pp. 78.

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Markree Observations of Double Stars, by W. Doberck, Ph. D., &c.

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The Observatory, Tokyo, Japan.

Revista do Observatorio do Rio de Janeiro, Marco—Agosto, 1890.
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Annuario Imp. Obs. do Rio de Janeiro, 1888-89-90, pp. 343, 322, 386.

The Imperial Observatory, Rio de Janeiro.

Boletin del Observatorio Astronomico Nacional de Tacubaya, Tome I. No. I.

The National Observatory, Tacubaya.

Anuario del Observatorio de la Plata para el Ano 1890, pp. 512.

The Observatory, La Plata.

Observations Astronomiques, par Baron d'Engelhardt, Deuxieme Partie, pp. 272.

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Influence de l'Altitude sur la Temperature, par Ch. André, pp. 16.

Meteorologie Lyonnaise, par Ch. André, 1883-84, pp. 56; 1885-86, pp. 68; and 1886-87, pp. 68.
Sur le Ligament Lumineux des Passages et Occultations des Satellites de Jupiter, Moyen de l'eviter, par Ch. André, pp. 5.
Elements Magnetiques a Lyon au Janvier 1, 1889, par Ch. André, pp. 2.

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Annales de l'Observatoire de Nice, Tome III., et Atlas.

R. L. Bischoffsheim.

Ephemeris of the Satellites of Saturn, 1889-90 (concluded), by A. Marth.
Ephemeris for Physical Observations of the Moon, January 1 to July 1, 1890, by A. Marth.
Ephemeris of the Satellites of Uranus, 1890, by A. Marth.
Ephemeris for Physical Observations of Mars, 1890, by A. Marth.
Ephemeris of the Satellites of Mars, 1890, by A. Marth.
Ephemeris for Physical Observations of Jupiter, 1890, by A. Marth.

The Author.

On the Orbit of Struve 228, by J. E. Gore.
On the Proper Motion of the Double Star South 503, by J. E. Gore.

The Author.

Report of the Rousdon Observatory for 1889. Sheet, by C. E. Peek, M.A., &c.
Meteorological Observations at Rousdon Observatory, Devon, for 1889, by C. E. Peek.

The Author.

Report on Astronomical Observatories for 1886, by G. H. Boehmer, Wash., 1889.

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On the Motions of the Planetary Nebulæ in the Line of Sight, by J. E. Keeler, pp. 8.

The Author.

Double-Star Observations made at the Lick Observatory, by S. W. Burnham.
Double-Star Observations made with the 36-inch refractor of the Lick Observatory, by S. W. Burnham.
Double-Star Observations made at the Lick Observatory in May, June, and July, 1889, by S. W. Burnham.
Photograph of Solar Eclipse of December 22, 1889.
Two Photographs of Lick Observatory.

S. W. Burnham.

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ERRATA.

In the History and Description of Mr. Tebbutt's Observatory, Windsor, New South Wales—

Page 22, line 23 from top, *for* 1886 *read* 1866.
Page 62, line 23 from top, *for* du *read* der.
Page 72, line 44 from top, *for* le *read* la.

In the Report for 1888—

For collimation errors opposite to May 6 and 7 on page 13, *for* — 0.7 and — 0.8 *read* + 0.7 and + 0.8 respectively.

Insert azimuth error — 4.72 from σ Octantis opposite to August 18 on page 16.

In the Report for 1889—

Remove square brackets from collimation error opposite to April 1 on page 11.

For γ^2 Piscis Australis, opposite to April 10 on page 12, *read* γ^2 Piscis Volantis.

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Ann Arbor Observatory
Michigan.
The United States

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1891.

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London ; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association ;
Corresponding Member of the Societé Ethnographique of Paris, and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

SYDNEY:
TURNER AND HENDERSON, PRINTERS,
HUNTER STREET.

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CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY,

FOR 1891.

AT the close of the year 1887, a pamphlet of 74 pages was published, entitled a " History and Description of Mr. Tebbutt's Observatory, Windsor, New South Wales." In this little volume is presented a detailed account of the observatory buildings, and of their instrumental equipment, and a list of all the scientific papers contributed by the proprietor to astronomical institutions, and of presents received by him for the library, down to the close of August, 1887. Since the year 1887, annual reports have been published of the work done at the Observatory in 1888, 1889 and 1890, and of the progress of the library. I have now the honour to report what has been done during the year 1891.

Buildings and Instruments.

No addition has been made either to the buildings or to the instruments described in the *History* above referred to. The construction of a larger circular chamber and revolving roof for the 8-inch equatorial, is, however, contemplated. The building which has accommodated the instrument for the past six years was originally erected for the 4½-inch equatorial, and is very inconvenient in connection with the larger instrument. An accident happened on July 8th to the spider lines of the Grubb filar-micrometer belonging to the 8-inch instrument. New lines were supplied by Mr. Wiesener, of Sydney. These were care-

fully examined by me for error in the perpendicularity of the position and distance threads. The distance threads were found to be accurately parallel, but it was found that when these threads were properly oriented the position thread made an angle of N. 0° 13′ W. to the true meridian. Corrections of observed differences of right ascension are, of course, applied for this error. A new investigation of the screw-values of this micrometer, and of the errors of the square bar-micrometer was also made during the year.

Position of the Observatory.

The co-ordinates of the Observatory are still adopted as :— Longitude from Greenwich = 10h. 3m. 20·51s. E. Astronomical latitude = — 33° 36′ 30·8″. (See pages 6 and 7 of the Report for 1888.)

Meridian Work.

The eight-day meantime chronometer, *John Poole*, No. 2962, having had its rate changed from mean to sidereal time in December, 1890, was substituted for chronometer *Parkinson* and *Frodsham,* No. 1042, and employed throughout the year 1891 in connection with the 3-inch transit instrument. It will be seen from the table which follows, that the behaviour of this time-keeper has been pretty good throughout. The method of determining the errors of the transit instrument has been already described in the Report for 1890, and a repetition of the description will here be unnecessary. It may be mentioned that the equatorial distances of the outer wires from the middle wire, adopted for the reductions of 1891, are those determined from the series of transits of circum-polar stars in 1890, namely :—A = + 20·040s., B = + 10·466s., D = − 9·468s., E = − 19·019s., with a reduction of + 0·404s. to the middle wire for the complete observation of an equatorial star. A reduction of all the transits of circum-polar stars during 1891, gives the following values for the wires :—A = +20·058s , B = +10·488s., D = −9·459s., E = − 19·018s., with a reduction of +0·414s. to the middle wire. These values will be employed for 1892. It will be seen from the table that the errors of the transit instrument have been as steady as

in former years, and no adjustment for either level, collimation, or azimuth was made during the year. The western pivot at the beginning of the year was relatively about 7″ too high, but it gradually fell till the depth of winter, when the axis became level, but by the end of the year the pivot had regained its former position. The extreme azimuth determinations were —13·13″, — 1·29″, the latter being a result from unfavourable stars. The mean of all the azimuth determinations for the year, 186 in number, is —7·87″. It must be understood that the instrumental errors in square brackets are simply interpolated. I must again record my indebtedness to the American Ephemeris for the apparent right ascensions of the southern circum-polar stars employed for azimuth. For the sake of uniformity, the apparent right ascensions of both clock and azimuth stars have been invariably taken from this publication.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
Jan. 1	7	E.W.	6·8	1·0	8·17 11·14	δ Hydri, δ Ceti, E. ι Hydri, ε Eridani, W.	2 45	1 53·20		
„ 2	5	W.	6·8	[1·0]	5·74	μ Hydri, γ Ceti	2 37	1 55·94	0·115	0·11
„ 3	5	W.	7·2	[1·0]	3·87	μ Hydri, γ Ceti	2 18	1 58·31	0·100	0·09
„ 4	4	W.	7·5	[1·1]	5·09	μ Hydri, γ Ceti	2 43	2 0·07	0·070	0·07
„ 8	1	W.	5·2	[1·1]	5·50	μ Hydri, σ Arietis	2 48	2 8·81	0·091	0·10
„ 12	6	W.E.	5·8	1 2	7·75 8·22	δ Hydri, γ Ceti, W. ι Hydri, ε Eridani, E.	3 22	2 19·49	0·111	0·11
„ 18	6	E.W.	5·1	4·2	7·29 8·64	ι Hydri, *f* Tauri, E. ε Tauri, δ Mensæ, W.	3 36	2 34·93	0·107	0·10
„ 20	4	W.	5·0	[4·1]	7·97	γ Hydri, A¹ Tauri	3 47	2 39·52	0·095	0·09
Feb. 7	6	W.E.	5·1	2·8	7·89	γ Tauri, δ Mensæ, W.	4 37	3 16·66	0·086	0·09
„ 8	3	E.	4·2	[3·1]	[8·2]		5 34	3 18·74	0·093	0·09
„ 9	4	E.	4·9	[3·4]	8·47	γ Tauri, δ Mensæ	5 24	3 20·98	0·094	0·10
„ 11	4	E.	5·0	[3·9]	8·50	δ Doradûs, α Orionis	5 51	3 25·80	0·100	0·10
„ 13	8	E.	4·7	[4·5]	6·44	γ Geminorum, ζ Mensæ	5 22	3 30·77	0·105	0·09
„ 14	7	E.W.	5·5	4·8	12 44	ε Orionis, δ Doradûs, W.	5 34	3 32·73	0·081	0·08
„ 17	6	W.	5·1	[4·0]	7·98	ζ Mensæ, 63 Aurigæ	5 43	3 39·02	0·087	0 08
„ 18	6	W.	7·3	[3·8]	5·39	β Cancri, θ Chamæleontis	7 38	3 41·15	0·082	0 08
„ 21	8	W.E.	4·8	3·0	6·17	ζ Mensæ, ζ Geminorum	5 59	3 46·39	0·075	0·09
Mar. 3	6	E.	4·0	[4·7]	6·86	ζ Mensæ, ζ Geminorum	6 6	4 10·74	0·101	0 09
„ 5	7	E.W.	5·5	5·0	8·19	ζ Mensæ, ζ Geminorum	6 8	4 14·84	0·085	0·08
„ 13	6	W.E.	5·8	2·0	8·69	ζ Mensæ, ζ Geminorum	6 43	4 30·32	0·080	0·08
„ 16	9	E.W.	6·2	4·6	9·39 7·42	ζ Mensæ, ζ Geminorum, W. γ² Pisc. Vol., δ Geminor., W.	6 56	4 36·13	0·080	0·08
„ 17	6	W.	6·2	[3·7]	6·59	30 Monocerotis, θ Chamæleontis	8 23	4 38·37	0·086	0·08

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
Mar. 18	5	W.	6·8	[2·8]	6·17	ζ Mensæ, ζ Geminorum	7 4	4 40·04	0·075	0·07
„ 20	10	W.E.	6·4	1·0	6·69	ζ Mensæ, ζ Geminorum, W.	7 37	4 43·49	0·071	0·07
„ 22	7	E.	6·1	[1·2]	7·39	30 Monocerotis, θ Chamæleontis	8 2	4 46·84	0·069	0·07
„ 25	4	E.	5·8	[1·6]	5·99	γ^2 Piscis Vol., β Canis Min.	7 17	4 52·24	0·076	0·08
„ 30	7	E.W.	6·1	2 2	8 05	30 Monocerotis, θ Chamæleontis	8 17	5 1·61	0·077	0·08
April 7	7	W.E.	5·4	2·4	6·47	30 Monocerotis, θ Chamæleontis	9 9	5 17·57	0·083	0·09
„ 9	5	E.	5·5	[2·6]	6·97	γ^2 Piscis Vol., δ Geminorum	7 12	5 21·74	0·091	0 08
„ 10	5	E.	5·8	[2·7]	7·59	γ^2 Piscis Vol., δ Geminorum	7 42	5 23·65	0·080	0·08
„ 11	2	E.	6·2	[2·8]	[8·0]		7 14	5 25·57	0·082	0·09
„ 12	6	E.	6·0	[2·9]	8·47	30 Monocerotis, θ Chamæleontis	8 7	5 27·78	0·089	0·09
„ 19	1	E.	4·7	[3·6]	[8·0]		8 16	5 42·80	0·090	0·09
„ 20	1	E.	3·5	[3·7]	[7·9]		9 28	5 44 96	0 086	0·09
„ 21	10	E.W.	4·8	3 8	5·51 10·14	30 Monocerotis, θ Chamæl., E. o Leonis, ζ Chamæl., W.	8 36	5 47·14	0·094	0·09
„ 21	3	W.	4·8	[3·8]	9·49	α Tri. Aust., κ Ophiuchi	16 42	5 47·84	0·086	0 09
„ 23	4	W.	5·1	[3·6]	7·77	θ Hydræ, β Argûs	8 51	5 51·59	0·093	0 09
„ 24	5	W.	4·9	[3·5]	9·99	o Leonis, ζ Chamæleontis	9 37	5 53 80	0·089	0 09
„ 30	8	W.E.	3·2	3·0	12·11	o Leonis, ζ Chamæleontis	10 4	6 8·13	0·099	0·10
May 4	2	E.	3·6	[3·0]	[11·1]		10 43	6 18·43	0·107	0·11
„ 5	6	E.	4·0	[3·0]	9 91 11·67	θ Hydræ, β Argûs o Leonis, ζ Chamæleontis	9 35	6 20 91	0 108	0·11
„ 8	12	E.W.	3·9	3·0	9·10 10 96	30 Monocerotis, θ Chamæl., E. o Leonis, ζ Chamæl., W.	9 30	6 28 28	0 103	0·13

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
May 9	13	W.E.	4·1	3·4	6·72 8·90 7·81 8·98	30 Monocerotis, θ Chamæl., W. θ Hydræ, β Argûs, W. ρ Leonis, W., η Argûs, E. 46 Leonis Min., η Octantis, E.	10 27	6 31·82	0·142	0·15
„ 9	7	E.	3·4	[3·3]	[8·6]		20 8	6 33·26	0·149	0·14
„ 10	11	E.W.	3·4	3·2	6·83 11·55	θ Hydræ, β Argûs, E. o Leonis, ζ Chamæleontis, W.	9 28	6 34·91	0·124	0·12
„ 11	3	W.	3·0	[3·2]	[9·5]		9 24	6 37·76	0·119	0·12
„ 12	8	W.	3·9	[3·3]	9·71	β Chamæleontis, β Hydri	11 46	6 40·84	0·117	0·11
„ 16	1	W.	3·6	[3·4]	[9·1]		10 9	6 49 03	0·087	0·09
„ 18	8	W.E.	3·5	3·4	11·45 7·76 7·34	θ Hydræ, β Argûs, W. 41 Leonis Min., η Argûs, E. δ^3 Chamæl., p^3 Leonis, E.	10 11	6 53·59	0·095	0·09
„ 23	6	E.	3·0	[3·8]	6·77	β Chamæleontis, β Hydri	11 55	7 4·81	0·092	0·08
„ 25	9	E.W.	3·7	4·0	8·02 10·44	o Leonis, ζ Chamæleontis, E. β Chamæleontis, β Hydri, W.	10 57	7 8·44	0·077	0·08
„ 26	4	W.	4·0	[3·8]	9·00	β Chamæleontis, β Hydri	12 0	7 10·53	0·083	0·08
June 3	4	W.	4·6	[2·4]	10·70	δ Muscæ, θ Virginis	12 46	7 26·36	0·082	0·09
„ 4	5	W.	4·3	[2·2]	[10·1]		23 38	7 29·69	0·096	0·08
„ 5	11	W.E.	3·7	2·0	10·83 8·05	l Leonis, η Octantis, W. β Chamæleontis, β Hydri, E.	11 49	7 30·55	0·071	0·08
„ 6	1	E.	2·7	[2·0]	[9·8]		13 27	7 32·83	0·089	0·09
„ 11	4	E.	2·4	[2·0]	11·41	κ Octantis, ζ Virginis	13 51	7 42·37	0·079	0·08
„ 12	9	E.W.	2·0	2·0	11·92	η Octantis, δ Leonis, E.	11 46	7 44·11	0·079	0·09
„ 13	4	W.	2·4	[2·0]	5·67	ρ Leonis, β Octantis, S.P.	10 29	7 46·55	0·107	0·10
„ 14	4	W.	2·3	[1·9]	7·60	η Virginis, α^1 Crucis	12 21	7 49·21	0·102	0·10

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			+	+	−					
1891.			"	"	"		H. M.	M. S.	S.	S.
June 27	5	W.E.	0·0	1·6	7·33	η Bootis, β Centauri, W.	14 28	8 15·16	0·083	0·08
„ 29	10	E.	0·5	[1·7]	9·10	β Chamæleontis, β Hydri	12 31	8 18·74	0·078	0·08
„ 30	4	E.	0·7	[1·7]	13·13	δ Muscæ, θ Virginis	13 22	8 20·70	0·083	0·08
			−	+	−					
July 2	5	E.	0·1	[1·9]	7·51	ε Serpentis, δ^1 Apodis	14 57	8 24·85	0·084	0·08
			+	+	−					
„ 3	6	E.	0·5	[1·9]	8·77	δ Muscæ, θ Virginis	12 56	8 26·72	0·085	0·08
„ 4	10	E.W.	0·7	2·0	10·12 9·97	β Chamæleontis, β Hydri, E. κ Octantis, ζ Virginis, W.	12 56	8 28·71	0·083	0·08
„ 6	5	W.	0·9	[1·9]	8·29	κ Octantis, ζ Virginis	13 46	8 33·09	0·081	0·08
„ 7	5	W.	0·8	[1·8]	7·23	β Chamæleontis, β Hydri	12 55	8 35·12	0·088	0·08
„ 8	2	W.	0·3	[1·8]	8·33	δ Octantis, δ Bootis	15 13	8 37·22	0·080	0·08
„ 9	5	W.	0·4	[1·7]	10·20	κ Octantis, ζ Virginis	13 47	8 39·02	0·080	0·08
„ 13	7	W.E.	0·1	1·4	8·34	κ Octantis, ζ Virginis, W.	13 37	8 46·54	0·079	0·08
„ 14	4	E.	0·0	[1·6]	11·16	α Apodis, ε Bootis	15 5	8 48·73	0·086	0·09
			−	+	−					
„ 15	7	E.	0·2	[1·8]	9·25 11·65	ρ Octantis, α Cor. Bor. α Tri. Aust., κ Ophiuchi	15 52	8 51·24	0·101	0·09
„ 17	10	E.	0·3	[2·2]	10·20 7·91	α Apodis, ε Bootis ε Delphini, β Pavonis	17 23	8 55·10	0·078	0·08
„ 18	5	E.	0·0	2·4	6·50	η Bootis, θ Apodis	14 15	8 56·91	0·087	0·08
			+	+	−					
„ 19	8	W.	0·9	[2·3]	9·95 9·51	η Bootis, θ Apodis α Apodis ε Bootis	14 26	8 58·62	0·071	0·08
„ 20	5	W.	1·3	[2·2]	8·96	ε Serpentis, δ^1 Apodis	15 55	9 0·91	0·090	0·09
„ 21	5	W.	1·3	[2·1]	9·21	α Apodis, ε Bootis	14 46	9 2·84	0·085	0·09

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
July 22	16	W.E.	0·2	2·0	9·75 6·34	η Bootis, θ Apodis, W. γ Aquilæ, ε Pavonis, E.	16 16	9 5·12	0·089	0·08
			−	+	−					
„ 23	6	E.	0·7	[2·0]	10·16	ε Serpentis, δ^1 Apodis	15 49	9 6·93	0·077	0·08
			+	+	−					
Aug. 7	7	E.W.	0·2	2·6	10·28 8·45	δ Ophiuchi, γ Apodis, E. α Tri. Aust., κ Ophiuchi, E.	16 54	9 34·74	0·077	0·07
„ 8	1	W.	0·4	[2·6]	[10·3]		16 18	9 36·30	0·067	0·06
„ 9	5	W.	1·0	[2·7]	11·21	ε Serpentis, δ^1 Apodis	16 12	9 37·78	0·062	0·07
„ 10	9	W.	1·7	[2·7]	8·38 9·04	α Tri. Aust., κ Ophiuchi σ Octantis	17 32	9 39·84	0·081	0·08
„ 11	10	W.	0·8	[2·8]	[8·0]		18 4	9 41·64	0·073	0·07
„ 12	10	W.E.	0·7	2·8	7·72 6·37 7·87	γ Draconis, γ^2 Sagittarii, W. η Serpentis, ζ Pavonis, E. σ Octantis, E.	17 50	9 43·34	0·072	0·07
„ 13	5	E.	0·3	[2·8]	8·38	α Tri. Aust., κ Ophiuchi	16 38	9 44·93	0·070	0·07
			−	+	−					
„ 14	7	E.	0·1	[2·9]	10·06 7·77	γ Draconis, γ^2 Sagittarii σ Octantis	17 24	9 46·83	0·077	0·08
			+	+	−					
„ 15	6	E.	0·5	[2·9]	7·06 8·25	δ^1 Apodis, β Herculis α Tri. Aust., κ Ophiuchi	16 52	9 48·63	0·077	0·08
„ 16	6	E.	1·0	[3·0]	5·76	γ Draconis, γ^2 Sagittarii	17 9	9 50·58	0·080	0·08
„ 17	7	E.W.	0·2	3·0	6·57 10·61	ε Serpentis, δ^1 Apodis, E. α Tri. Aust., κ Ophiuchi, W.	16 46	9 52·33	0·074	0·09

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
Aug. 18	5	W.	1·0	[2·3]	11·05 10·80	δ Ophiuchi, γ Apodis α Tri. Aust., κ Ophiuchi	17 9	9 54·72	0·098	0·11
„ 19	10	W.	1·4	[1·7]	7·03 8·18 9·24	γ Apodis, β Herculis α Tri. Aust., κ Ophiuchi σ Octantis	17 58	9 57·70	0·120	0·12
„ 20	10	W.E.	1·1	1·0	7·98	δ Ophiuchi, γ Apodis, W.	17 27	10 0·67	0·127	0·13
„ 21	5	E.	0·8	[1·3]	9 72	δ[1] Apodis, δ Ophiuchi	16 46	10 3·78	0·133	0·12
„ 22	5	E.	0·3	[1·7]	10·67	α Tri. Aust., κ Ophiuchi	17 2	10 6·43	0·109	0·12
„ 23	10	E.W.	0·6	2·0	9·81 9·10	δ Ophiuchi, γ Apodis, E. α Tri. Aust., κ Ophiuchi, E.	17 9	10 9·53	0·129	0·14
„ 24	4	W.	2 7	[1·9]	7·99	α Tri. Aust., κ Ophiuchi	17 7	10 12·93	0·142	0·13
„ 25	2	W.	1·8	[1·8]	[8·0]		17 28	10 15·86	0·120	0·11
„ 26	2	W.	1·1	[1·7]	[8·1]		18 25	10 18·51	0·106	0·11
„ 28	5	W.	1·8	[1·4]	[8·1]		17 41	10 23·42	0·104	0.10
„ 30	5	W.E.	1·6	1·2	6·13 10·36	η Serpentis, ζ Pavonis, W. σ Octantis, E.	18 46	10 27·79	0·089	0·08
„ 31	4	E.	1·5	[1·3]	[8·9]		18 21	10 29·71	0·081	0·08
Sept. 1	3	E.	1·5	[1·4]	9·60	σ Octantis	17 58	10 31·53	0·077	0·08
„ 2	4	E.	2·2	[1·5]	9·28	σ Octantis	17 23	10 33·53	0·085	0.09
„ 3	3	E.	2·1	[1·6]	[9·6]		19 21	10 35 92	0·092	0·09
„ 4	3	E.	2·8	[1·7]	9·95	α Tri. Aust., κ Ophiuchi	16 44	10 37 64	0·080	0·09
„ 5	6	E.	2·8	[1·7]	[8·9]		17 53	10 40·05	0·096	0·10
„ 7	5	E.	2·6	[1·9]	6·86	η Serpentis, ζ Pavonis	18 20	10 44·65	0·095	0·10
„ 8	10	E.W.	3·3	2 0	8·64 10·55	η Serpentis, ζ Pavonis, W. σ Octantis, W.	18 9	10 47·21	0.108	0·11
„ 9	6	W.	2·6	[1·9]	8·51	σ Octantis	19 25	10 49·84	0·104	0·12

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			″	″	″		H. M	M. S.	S.	S.
Sept. 10	10	W.	3·0	[1·7]	6·56	σ Octantis	18 54	10 52·82	0·127	0·14
„ 11	10	W.E.	1·8	1·6	7·28	ϵ Pavonis, γ Sagittæ, E.	18 13	10 56·28	0·148	0·14
„ 12	4	E.	1·8	[1·5]	11·25	σ Octantis	17 55	10 59 32	0·128	0·12
„ 15	10	E.W.	1·3	1·2	8·51 10 92	η Serpentis, ζ Pavonis, E. σ Octantis, E.	19 47	11 7·98	0 117	0·11
„ 16	6	W.	2·3	[1·5]	6 51	β Aquarii, λ¹ Octantis	21 31	11 10 93	0·115	0·11
„ 17	2	W.	2·4	[1·9]	[6·6]		17 18	11 13·00	0·105	0·10
„ 18	6	W.E.	2 6	2·2	7·81 5·46	σ Octantis, W. γ Aquilæ, ϵ Pavonis, E.	19 30	11 15·49	0 095	0·09
„ 19	4	E.	2·1	[2·2]	7·83	σ Octantis	18 21	11 17·62	0·093	0·09
„ 21	5	E.	2·4	[2·3]	5·31	γ Aquilæ, ϵ Pavonis	19 55	11 22·43	0 097	0·09
„ 23	4	E.	2·1	[2·3]	5·88	β Aquarii, λ¹ Octantis	21 37	11 26·95	0·091	0·10
„ 24	2	E.	2·6	[2·3]	[6·3]		19 48	11 29 19	0·101	0·10
„ 28	1	E.	2·5	[2·4]	8·14	α Aquarii, υ Octantis	22 12	11 38 07	0 090	0 09
„ 29	6	E.W.	3·2	2·4	7·99	γ Aquilæ, ϵ Pavonis, W.	19 40	11 39·99	0·089	0·09
Oct. 1	5	W.	5·0	[1·8]	5·82	γ Aquilæ, ϵ Pavonis	19 38	11 44·79	0·100	0·09
„ 2	4	W.	4·0	[1·5]	4·43	ϵ Pavonis, θ Aquilæ	20 0	11 46·76	0·081	0·09
„ 4	2	W.	4·2	[0·9]	[4·7]		23 2	11 51·59	0·095	0 11
„ 5	4	W.	4·0	[0·5]	4·90	γ Aquilæ, ϵ Pavonis	19 34	11 53·88	0·112	0·11
„ 6	4	W.	4·4	[0·2]	4·59	γ Aquilæ, ϵ Pavonis	19 46	11 56·40	0·104	0·11
			+	−	−					
„ 7	5	W.	4·1	[0·1]	[6 6]		21 27	11 59·16	0·108	0 10
„ 8	7	W.E.	2·9	0·4	8·57	β Aquarii, λ¹ Octantis, E.	20 54	12 1·52	0·101	0·10
			+	+	−					
„ 9	5	E.	5·1	[1·0]	5·36 7·90	γ Aquilæ, ϵ Pavonis β Aquarii, λ¹ Octantis	20 58	12 3·84	0·096	0·10

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
Oct. 10	7	E.W.	5·5	2·4	5·82	γ Aquilæ, ε Pavonis, E.	20 12	12 6·06	0·096	0·10
,, 11	4	W.	4·7	[2·2]	6·34	γ Aquilæ, ε Pavonis	20 1	12 8·76	0·113	0·11
,, 12	4	W.	5·1	[1·9]	[6·9]		20 8	12 11·28	0·105	0·11
,, 13	3	W.	5·5	[1·7]	7·42	α Aquarii, υ Octantis	22 1	12 14·51	0·125	0·12
,, 15	5	W.	4·7	[1·3]	5·71	β Aquarii, λ^1 Octantis	21 17	12 20·58	0·128	0·13
,, 18	5	W.E.	4·0	0·6	7·94	λ^1 Octantis, ε Pegasi, E.	20 55	12 29·86	0·130	0·15
,, 19	3	E.	4·0	[0·7]	[8·4]		20 53	12 33·59	0·156	0·15
,, 22	4	E.	4·8	[1·0]	9·93	ε Delphini, β Pavonis	21 4	12 43·25	0·134	0·13
,, 23	2	E.	4·3	[1·1]	[8·7]		22 15	12 46·33	0·122	0·11
,, 24	2	E.	4·4	[1·1]	[7·5]		22 16	12 48·91	0·108	0·11
,, 25	3	E.	5·3	[1·2]	6·31	β Aquarii, λ^1 Octantis	21 31	12 51·79	0·123	0·12
,, 29	6	E.W.	7·0	1·6	5·38	β Aquarii, λ^1 Octantis, E.	22 15	13 2·51	0·111	0·09
,, 30	4	W.	7·4	[1·7]	6·14	β Aquarii, λ^1 Octantis	21 39	13 4·57	0·088	0·11
,, 31	3	W.	6·8	[1·7]	4·08	β Aquarii, λ^1 Octantis	21 40	13 7·88	0·138	0·14
Nov. 1	5	W.	7·8	[1·8]	5·42	α Aquarii, υ Octantis	22 15	13 11·24	0·137	0·15
,, 2	4	W.	7·5	[1·9]	4·35	γ^1 Octantis, ω Piscium	23 27	13 15·51	0·169	0·17
,, 3	4	W.	5·9	[1·9]	3·17	β Aquarii, λ^1 Octantis	22 7	13 19·29	0·167	0·16
,, 4	6	W.E.	5·7	2·0	5·14	α Aquarii, υ Octantis, W.	22 49	13 22·99	0·150	0·15
,, 5	3	E.	6·6	[2·1]	[6·0]		22 32	13 26·38	0·143	0·14
,, 7	4	E.	6·8	[2·2]	7·60	η Aquarii, β Octantis	22 44	13 32·99	0·137	0·13
,, 10	5	E.	4·7	[2·4]	7·41	ξ^1 Ceti, δ Hydri	1 51	13 42·78	0·130	0·11
,, 11	1	E.	6·8	[2·5]	6·68	β Andromedæ, κ Tucanæ	1 17	13 45·31	0·108	0·11
,, 13	6	E.W.	5·2	2·6	6·58	β Chamæleontis, β Hydri, W.	0 19	13 51·22	0·125	0·13
,, 14	2	W.	5·1	[2·6]	[5·4]		0 36	13 54·35	0·129	0·13
,, 15	4	W.	5·7	[2·6]	4·29	η Aquarii, β Octantis	23 24	13 57·32	0·130	0·12

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1891.			"	"	"		H. M.	M. S.	S.	S.
Nov. 16	10	W.E.	6·8	2·6	3·80 5·50 6·33	γ^1 Octantis, ω Piscium, W. α Ceti, ι Hydri, W. γ Hydri, o^1 Eridani, E.	1 53	14 0·03	0·102	0·10
„ 24	4	E.	5·9	[2·8]	5·55	β Chamæleontis, β Hydri	0 2	14 19·84	0·104	0·10
„ 26	4	E.	6·2	[2·8]	1·29	Achernar, ν Piscium	1 41	14 24·81	0·100	0·10
Dec. 4	5	E.W.	4·8	3·0	6·41	β Chamæleontis. β Hydri, E.	0 49	14 42·42	0·092	0·06
„ 5	4	W.	6·4	[2·8]	8 50	ε Piscium, κ Tucanæ	1 29	14 43·80	0·056	0·07
„ 6	10	W.E.	6·1	2·6	4·44 8·42	33 Piscium, β Hydri, W. α Ceti, ι Hydri, E.	2 0	14 45·99	0·089	0·09
„ 9	2	E.	5·8	[2·7]	[6·0]		0 59	14 52·47	0·091	0·09
„ 11	8	E.	6·4	[2·8]	5·66	ζ Arietis, ι Hydri	4 38	14 56·78	0·083	0·07
„ 12	10	E.W.	6·2	2·8	6·89 6·59	ε Piscium. κ Tucanæ, E. δ Hydri, δ Ceti, W.	2 6	14 58·18	0·065	0·09
„ 13	4	W.	7·3	[2·6]	[6·3]		1 47	15 0·56	0·101	0·10
„ 14	3	W.	7·3	[2·4]	5·86	ε Piscium, κ Tucanæ	1 22	15 3·13	0·109	0·11
„ 17	5	W.	8·4	[1·9]	5·14	η Tauri, γ Hydri	2 8	15 10·65	0·103	0·12
„ 20	8	W.E.	6·1	1·4	8·41	γ Tauri, δ Mensæ, E.	2 11	15 19·83	0·127	0·13
„ 21	5	E.	6·7	[2·0]	6·37	ξ^1 Ceti, δ Hydri	2 9	15 22·91	0·129	0·13
„ 22	4	E.	6·8	[2·6]	[6·2]		2 7	15 25·87	0·124	0·12
„ 25	4	E.	7·1	[4·4]	5·77	δ Hydri, δ Ceti	2 48	15 33·61	0·107	0·14
„ 26	8	E.W.	6·9	5·0	5·51	μ Hydri, γ Ceti, W.	2 16	15 37·23	0·154	0·15
„ 27	3	W.	5·9	[4·5]	5·71	μ Hydri, γ Ceti	2 51	15 40·62	0·138	0·14
„ 28	5	W.	6·3	[4·0]	4·63	μ Hydri, γ Ceti	2 32	15 43·94	0·140	0·13
„ 30	8	W.E.	6·4	3·0	7·89	ι Hydri, f Tauri, E.	3 32	15 49·38	0·111	

Note.—The transit instrument was reversed on July 18, but in consequence of clouds transits could not be observed with the clamp west.

Extra-Meridian Work.

THE early part of the year 1891, like that of 1890, was characterised by cloudy weather. The following is an abstract of the work done in this department:—

OCCULTATIONS OF STARS BY THE MOON.—Forty-six occultations were observed, comprising forty-four different stars and fifty-six phases. Of the stars thirty-seven have been identified. Of the disappearances three are at the bright and forty-two at the dark limb, and of the reappearances eight are at the bright and three at the dark limb. An unidentified star was also observed to graze the moon's south limb. The satisfactory result in this department of observation is in a great measure due to the interest of Mr. R. T. A. Innes of Sydney, F.R.A.S., who kindly supplied me with prediction calculations of the occultations of Nautical Almanac Stars for the last eleven months of the year. The results have already appeared in the *Astronomische Nachrichten*. The total number of occultation phases observed here during the period 1864-1891 is 489, namely, 462 disappearances and 27 reappearances. The disproportion is due to the circumstance that prediction calculations have seldom been made.

PHENOMENA OF JUPITER'S SATELLITES:—These have been observed chiefly with the 8-inch equatorial, and are classified thus:—Transit ingress—I.1., II.2, III.1. Transit egress—I.6., II.3., III.3; Occultation disappearances, I.4, II.1, III.1; Occultation reappearance, IV.1; Eclipse disappearance, II.1; Eclipse reappearances, I.4., II.3, IV.1. These observations have been sent to the Royal Astronomical Society. Physical observations of some of the satellites were also made during their transits.

TRANSIT OF MERCURY, MAY 9-10.—This was observed in both phases with the 4½-inch equatorial, the observation of the egress being especially good. The observations have already been published in the *Astronomische Nachrichten*.

CONJUNCTION OF VENUS AND JUPITER, APRIL 7, 1891.—This was well observed with the filar micrometer on the 8-inch equatorial, and the results have already appeared in the R.A.S. Monthly Notices.

THE MINOR PLANET CERES.—An excellent series of filar micrometer comparisons was obtained with the 8-inch equatorial between the parallels of 26 and 28 degrees south declination, on August 15, 16, 17, 18, 19, 20, 30, 31, September 1, 2, 3, 1891, comprising 106 comparisons, and four comparison stars. The observations have been sent to the *Astronomische Nachrichten.*

COMETS.—The following comets were observed with the square bar-micrometer on the 8-inch equatorial:—68 comparisons of Comet (Barnard-Denning) 1891, between 37° and 47° south declination on June 4, 11, 12, 13, 14, 29, July 2, 3, 1891, and 102 comparisons of Comet Wolf II., 1891, between declinations 10° north and 15° south, on October 9, 11, 30, 31, November 2, 3, 4, 7, December 17, 20, 21, 25, 26, 1891. The former have already appeared in the *Astronomische Nachrichten,* and the latter have recently been sent to that Journal.

DOUBLE STARS.—The following interesting double stars have been observed with the 8-inch telescope, and the results published in the *Monthly Notices* of the Royal Astronomical Society:—*p* Eridani, Lalande 4219, α Centauri, 39 Ophiuchi, κ Coronæ Australis, Brisbane 6556, *h* 5075, and γ Coronæ Australis.

VARIABLE STARS.—The only variable stars attended to during the past year are η Argûs and *R.* Carinæ. The former has been systematically watched here during the past thirty years, and the latter for the last eleven years. No change has been noticed in the former during the year. A determination of the maximum of the latter (5·5 mag.) was made in March, being the eleventh determined at this Observatory since 1879.

Meteorological Observations.

The 9h. a.m. observations have been taken during the year with great regularity, and the abstract results for 1886, 1887, 1888, 1889 and 1890 have been published, and many copies

already distributed. The daily rainfall results have, as usual, been sent to the Government Astronomer for incorporation with similar results from the Government Meteorological Stations. The Windsor meteorological observations now extend over a period of twenty-nine years.

Publications.

The following is a list of the papers published by the author in journals and transactions of scientific societies since the Report for 1890 :—

Observations of the Minor Planets Ceres, Juno, Ariadne, and Undina, in 1890.—See Report for 1890, p. 17. *Astronomische Nachrichten,* Band CXXVI., No. 3020, p. 323.

Observations of Comet VI. (Denning), 1890, and Comet V. (D'Arrest), 1890.—See Report for 1890, p. 18. *Astronomische Nachrichten,* Band CXXVI., No. 3022, p. 357.

Double-Star Measures in 1889 and 1890.—*R.A.S. Monthly Notices,* Vol. LI., p. 331.

Observations of Phenomena of Jupiter's Satellites in 1890.—*R.A.S. Monthly Notices,* Vol. LI., p. 420.

On the Colour of *r* Velorum.—*Journal of the British Astronomical Association,* Vol. I., p. 423.

Star Occultations Observed in 1890.—*Astronomische Nachrichten,* Band CXXVII., No. 3036, p. 193.

Note on Dark Transits of Jupiter's Satellites.—*Publications of the Astronomical Society of the Pacific,* Vol. III., p. 221.

Observation of the Transit of Mercury, May 9-10, 1891.—*Astronomische Nachrichten,* Band CXXVIII., No. 3050, p. 25.

Observations of Comet I. (Barnard-Denning), 1891.—*Astronomische Nachrichten,* Band CXXVIII., No. 3059, p. 203, and Band CXXVIII., No. 3060, p. 221.

On Observing Occultations and the Misuse of Scientific Symbols.—*Observatory,* Vol. XIV., No. 179, p. 310.

OBSERVATION OF THE DARK TRANSIT OF JUPITER'S THIRD SATELLITE, ON AUGUST 20, 1891.—*Publications of the Astronomical Society of the Pacific,* Vol. III., p. 353.

OBSERVATION OF THE CONJUNCTION OF VENUS AND JUPITER, APRIL 7, 1891.—*R.A.S. Monthly Notices,* Vol. LI., p. 561.

DOUBLE-STAR MEASURES IN 1891.—*R. A. S. Monthly Notices* Vol. LII., p. 386.

STAR OCCULTATIONS OBSERVED IN 1891.—*Astronomische Nachrichten,* Band CXXIX., No. 3090, p. 307.

OBSERVATION OF COMET, 1892 (SWIFT, MARCH 6), ON MARCH 10, 1892.—*Astronomische Nachrichten,* Band CXXIX., No. 3090, p. 309.

The Library.

The library has now attained considerable dimensions for a small establishment. At the end of the Report will be found a grateful acknowledgment of all the presents received during the year 1891. It will be well to notify correspondents and intending donors of publications, that the author's correct address is "The Observatory, the Peninsula, Windsor, New South Wales." Correspondence and packets have, on many occasions, been addressed to "Windsor, Australia," and have consequently been delayed in transmission, by being first sent to Windsor in the adjacent Colony of Victoria.

Conclusion.

The proprietor has made all the astronomical, and nearly all the meteorological observations, and has executed the greater portion of the reductions. The work for 1892 will be similar to that carried out in 1891, special attention being paid to Occultations and southern Comets, and to the meteorological observations.

July 1st, 1892.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1891.

[NOTE.—The Names of the Donors are printed in Italics.]

Monthly Records of Results of Observations in Meteorology, Terrestrial Magnetism, etc., at the Melbourne Observatory, with Meteorological Abstracts from various localities in Victoria. Monthly parts from August, 1890, to August, 1891.

The Melbourne Observatory.

Rainfall Returns of South Australia. Monthly parts from September, 1890, to September, 1891.

Meteorological Observations at Adelaide Observatory and other places in South Australia, etc., during 1883 and 1888, pp. 277 and 94.

Rainfall in South Australia and the Northern Territory in 1890, with Map.

The Adelaide Observatory.

Rainfall Map for Tasmania for 1890.

Mean Rainfall Map for Tasmania previous to 1890.

Rainfall in Tasmania for January, 1891.

Monthly Record of Results of Meteorological Observations at Hobart, etc., from January to October, 1891. (August missing.)

The Meteorological Observatory, Hobart.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, Vol. VI., Parts I. and II., pp, 101.

Queensland Branch of the Society.

"The Surveyor" for January 6, February 3, March 3, April 7, May 5, June 2, July 7, August 4, September 1, October 6, November 6, December 5, 1891.

Institution of Surveyors, New South Wales.

Catalogue of the Crawford Library of the Royal Observatory, Edinburgh, pp. 497.

The Royal Observatory, Edinburgh.

Results of Astronomical and Meteorological Observations at Radcliffe Observatory, Oxford, in 1886, pp. 108 and 129.

The Radcliffe Observatory, Oxford.

Meteorological Observations at Sanchez (Samana Bay), St. Domingo, 1886-1888, by the late W. Reid, M.D., pp. 64.

Variability of the Temperature of the British Isles, 1869-1883, by R. H. Scott, F.R.S.

Report of the Meteorological Council of the Royal Society for year ending March 31, 1890, pp. 147.

Meteorological Observations at Stations of the Second Order for 1886, pp. 180.

Quarterly Weather Report of the Meteorological Office, Part II., April-June, 1880, pp. 70, with charts.

Summary of Observations at Stations included in Daily and Weekly Weather Reports for October, November, December, 1880, and March to December, 1890.

Weekly Weather Reports, May 24 to January 3, 1891.

Quarterly Summary of Weekly Weather Reports, April-June, July-September, and October-December, 1890.

Summary of the Weekly Weather Reports, 1890, Appendices I., II., III., IV.

The Meteorological Office, London.

Report of the Kew Committee for the year ending October 31, 1890.

A Brief Notice respecting Photography in relation to Meteorological Work, by G. M. Whipple, B.Sc., etc., pp. 6.

Appendix to the Report of the Kew Observatory for 1890, pp. 11.

The Kew Observatory.

Report of the Temple Observatory, Rugby, for 1890, pp. 4.

The Temple Observatory.

Results of Meteorological, Magnetical, and Solar Observations at Stonyhurst College Observatory for 1889 and 1890, pp. 79 and 67.

The Stonyhurst College Observatory.

Report of Rousdon Observatory, Lyme Regis, for 1890. Sheet.

C. E. Peek, F.R.A.S.

Results of Observations of Fixed Stars with the Meridian Circle, at the Government Observatory, Madras, in 1868, 1869 and 1870, pp. 266.

The Madras Observatory.

Annual Reports of the Smithsonian Institution to July, 1888, and July, 1889, pp. XLI., 839, and XLVI., 815.

The Smithsonian Institution.

Observations at the U.S. Naval Observatory in the year 1884, pp. XCII., 343, and Appendix, pp. XXV., 302.

Observations at the U.S. Naval Observatory in the year 1885, pp. CVI., and 298, Appendix, pp. 354, with plates; Appendix II., pp. 22, with plates; and Appendix III., pp. 169.

The International Astrophotographic Congress, and a Visit to Certain European Observatories and Other Institutions, by A. G. Winterhalter, being Appendix I. to the Washington Observations for 1885, pp. 354, with plates.

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REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1892.

BY

JOHN TEBBUTT.

Fellow of the Royal Astronomical Society, London: Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association;
Corresponding Member of the Societé Ethnographique of Paris, and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

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1893.

CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY,

FOR 1892.

THE following Report contains a summary of the work done at the Observatory during the year 1892, and it will be found to be about the most satisfactory yet presented.

Buildings and Instruments.

The buildings and instruments have not been added to during the year. An enlargement of the circular chamber which accommodates the 8-inch equatorial was contemplated, but this desirable improvement has not yet been carried out.

Position of the Observatory.

No further investigation of the geographical position of the Observatory has been made. The old co-ordinates are, therefore, still adopted, namely:—Longitude from Greenwich = 10h. 3m. 20·51s. E.; Latitude = — 33° 36′ 30·8″.

Meridian Work.

The sidereal chronometer, *John Poole,* No. 2962, was employed throughout the year as the time-keeper of the Observatory, being regulated by means of the 3-inch transit instrument described in former reports. The customary table is given showing the errors of the transit instrument and of the chronometer, and it will be seen that the rate of the latter has been satisfactory. It will be unnecessary to repeat here the description of the methods by which the errors of the transit instrument

are determined, and the reader is therefore referred to the report for 1890. The equatorial distances of the outer wires from the middle wire in sidereal time were adopted as: A = + 20·058s., B = + 10·488s., D = − 9·459s., E = − 19·018s. with a reduction of + 0·414s. to the middle wire for an equatorial star when all the wires have been observed. These values were derived from a reduction of all the transits of circumpolar stars observed in 1891. A reduction of all the transits of circumpolar stars for 1892 gives the following values:—A = + 20·060s., B = + 10·508s., D = − 9·463s., E = − 19·013s., with a reduction of + 0·418s. to the middle wire. These will be employed for 1893. It will be seen from the table that only one adjustment was made for level and that none was made for either collimation or azimuth during the year. The number of separate determinations for level, collimation and azimuth were respectively 380, 43 and 163. To understand the steadiness of the last two adjustments it will only be necessary to inspect the following table, which gives the extreme values of the errors for each of the last five years, for it must be borne in mind that no adjustment has been made in either respect during that period:—

Year.	Collimation Error.			Azimuth Error.			
	No. of Determinations.	Extremes.		No. of Determinations.	Extremes.		Mea
		″	″		″	″	″
1888.	54	+4·5	−1·5	89	−13·05	−0·28	−5·37
1889.	42	+3·6	0·0	105	−14·94	−1·45	−8·09
1890.	38	+4·4	+0·6	133	−13·96	−3·92	−9.32
1891.	50	+5·0	−0·4	186	−13·13	−1·29	−7.87
1892.	43	+3·8	0·0	163	−10·30	+0·24	−5·15

In the following table the errors enclosed in square brackets have been simply interpolated from preceding and following observed values. The apparent right ascensions of both clock and azimuth stars have throughout been interpolated from the *American Ephemeris*, and corrected for daily aberration. In this connection it will not, perhaps, be thought impertinent to

point out a serious defect in the Star Ephemeris of our own *Nautical Almanac*, and that is the almost total absence of stars useful for the determination of azimuths in the Southern Hemisphere. A few southern stars were added to the list in 1891, but they are not sufficiently south to afford good determinations of azimuth. The addition of stars of the 6th magnitude and upwards in high south declination, if only one for each hour of right ascension, would be a decided improvement in this respect; and it is hoped this suggestion may not pass unnoticed by the present worthy superintendent of the national ephemeris.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			″	″	″		H. M.	M. S.	S.	S.
1892. Jan. 2	4	E.	5·6	[3·0]	3·25	μ Hydri, γ Ceti	3 20	15 58·39	0·126	0·13
„ 4	10	E.W.	6·4	3·0	5·32 3·02 3·83	67 Ceti, δ Hydri, E. μ Hydri, γ Ceti, E. ι Hydri, *f* Tauri, W.	3 10	16 4·79	0·134	0·13
„ 7	8	W.E.	6·4	3·0	4·61 3·69	ι Hydri, *f* Tauri, W. δ Mensæ, α Tauri, E.	4 14	16 14·59	0·134	0·13
„ 18	12	E.W.	5·4	3·2	3·50 5·34	η Tauri, γ Hydri, E. δ Mensæ, τ Tauri, W.	6 23	16 44·76	0·113	0·10
„ 20	5	W.	4·9	[3·2]	3·76	ι Hydri, *f* Tauri	4 4	16 49·27	0·099	0·10
„ 25	2	W.	5·5	[3·0]	[3·8]		5 23	17 0·34	0·091	0·09
Feb. 4	8	W.E.	3·7	2·6	3·92	ε Tauri, δ Mensæ, W.	5 13	17 25·05	0·103	0·10
„ 5	5	E.	4·5	[2·6]	3·60	ε Orionis, δ Doradûs	5 23	17 27·43	0·099	0·10
„ 17	5	E.	4·2	[2·0]	6·40	η Octantis, τ Leonis	11 54	17 56·00	0·097	0·10
„ 18	2	E.W.	4·0	2·0	[4·2]		8 25	17 58·03	0·099	0·09
„ 19	6	W.	4·2	[2·0]	1·94	ζ Mensæ, ζ Geminorum	5 59	17 59·73	0 079	0·08
			+	+	+					
March 7	10	W.E.	1 8	3·0	0·24 − 1·51	γ² Piscis Vol., β Canis Min. W. β Cancri, θ Chamæl., E.	7 43	18 36·84	0·091	0·06
			+	+						
„ 8	7	E.	2·2	[3·3]	2·15	ζ Mensæ, Procyon	6 45	18 38 24	0·061	0·06
„ 9	5	E.	2·4	[3·5]	1·41	γ² Piscis Vol., δ Geminor.	7 41	18 39·93	0·068	0·07
„ 10	8	E.W.	3 9	3·8	3·67	ζ Mensæ, ζ Geminor., W.	6 51	18 41·66	0·075	0·07
„ 13	7	W.	2·1	[3·6]	[3.7]		6 57	18 47·10	0·076	0·07
„ 20	3	W.	2·7	[3·1]	[3·8]		8 22	18 59·64	0·074	0·06
„ 21	2	W.	4·8	[3·1]	[3·8]		7 27	19 0·91	0·055	0·05
„ 21	2	W.	4·3	[3·1]	[3·8]		18 10	19 1·42	0·048	0·05

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892.			"	"	"		H. M.	M. S.	S.	S.
Mar. 22	10	W.E.	3·6	3·0	3·80	30 Monocerotis, θ Chamæl., E.	8 7	19 2·12	0·050	0·06
„ 23	2	E.	3·6	[3·0]	[3·7]		8 7	19 3·59	0·061	0·06
„ 24	1	E.	4·7	[3·0]	[3·6]		7 58	19 4·81	0·051	0·04
„ 25	8	E.	3·0	[3·0]	4·04 3·00	γ^2 Piscis Vol., β Canis Min. 30 Monocerotis, θ Chamæl.	8 9	19 5·69	0·036	0·04
„ 26	2	E.	4·4	[3·0]	[5·3]		7 52	19 6·70	0·043	0·04
„ 26	6	E.	4·6	[3·0]	6·19	η Serpentis, ζ Pavonis	18 26	19 7·14	0·042	0·04
„ 27	4	E.W.	3·9	3·0	[5·7]		7 49	19 7·56	0·031	0·04
„ 29	7	W.	4·0	[3·1]	3·84	30 Monocerotis, θ Chamæl.	8 7	19 10·83	0·068	0·07
April 2	1	W.	2·8	[3·2]	[4·9]		8 30	19 18·04	0·075	0·07
„ 4	2	W.	3·0	[3·3]	[5·5]		9 57	19 21·35	0·067	0·06
„ 7	8	W.E.	2·4	3·4	6·31	ρ Leonis, δ^2 Chamæl., E.	10 16	19 25·57	0·058	0·06
„ 8	6	E.	2·6	[3·2]	[6·0]		8 37	19 26·93	0·061	0·06
„ 9	8	E.	2·4	[3·1]	5·62	θ Hydræ, β Argûs	8 48	19 28·43	0·062	0·08
„ 10	2	E.	2·6	[3·0]	[4·9]		7 56	19 30·54	0·091	0·08
„ 10	3	E.	1·8	[3·0]	[4·5]		19 50	19 31·47	0·078	0·08
„ 11	10	E.W.	2·5	2·8	3·92 4·28	30 Monocerotis, θ Chamæl., E. θ Hydræ, β Argûs, W.	8 45	19 32·48	0·083	0·08
„ 12	6	W.	1·8	[2·6]	5·88	30 Monocerotis, θ Chamæl.	8 31	19 34·60	0·089	0·09
„ 14	6	W.	2·0	[2·2]	3·20	b Ophiuchi, β Draconis	17 26	19 40·44	0·103	0·09
„ 15	5	W.	3·1	[2·2]	4·47	30 Monocerotis, θ Chamæl.	8 25	19 41·81	0·092	0·09
„ 16	10	W.E.	2·3	2·0	5·63 6·29	30 Monocerotis, θ Chamæl., W. θ Hydræ, β Argûs, E.	8 56	19 44·11	0·094	0·07
„ 16	4	E.	1·7	[2·0]	6·03	ρ Octantis, α Serpentis	15 51	19 44·54	0·062	0·06
„ 17	5	E.	1·6	[2·0]	5·80	30 Monocerotis, θ Chamæl.	8 56	19 45·55	0·059	0·06
„ 18	3	E.	0·5	[2·1]	[5·9]		9 27	19 47·47	0·078	0·08

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892			"	"	"		H. M.	M. S.	S.	S.
April 22	10	E.W.	2·1	2·2	5·36 7·32	θ Hydræ, β Argûs, E. o Leonis, ζ Chamæleontis, W.	9 31	19 56·25	0·091	0·10
„ 23	4	W.	2·9	[2·2]	6·59	30 Monocerotis, θ Chamæl.	10 4	19 58·64	0·097	
„ 24	6	W.	2·8	[2·1]	5·49	θ Hydræ, β Argûs,	8 50	1 19·92		
„ 27	10	W.E.	2·5	2·0	5·89 8·35	θ Hydræ, β Argûs, W. o Leonis, ζ Chamæleontis, E.	9 22	1 26·05	0·085	0·08
„ 28	5	E.	1·7	[2·1]	5·89	θ Hydræ, β Argûs	9 2	1 28·07	0·085	0·09
„ 29	6	E.	1·6	[2·1]	4·35	θ Hydræ, β Argûs	8 46	1 30·11	0·086	0·09
„ 30	5	E.	1·5	[2·2]	6·73	β Chamæleontis, β Hydri	2 11	1 32·79	0·098	0·09
May 1	6	E.	0·7	[2·3]	4·15	θ Hydræ, β Argûs	18 44	1 34·46	0·081	0·09
„ 2	3	E.	1·4	[2·3]	[5·3]		12 2	1 37·01	0·093	0·10
„ 3	8	E.W.	1·4	2·4	[6·5]		11 21	1 39·41	0·103	0·10
„ 4	5	W.	2·7	[2·3]	7·60	l Leonis, η Octantis	10 43	1 41·70	0·098	0·10
„ 5	5	W.	2·1	[2·3]	5·83	β Chamæleontis, β Hydri	11 34	1 44·13	0·098	0·10
„ 6	5	W.	2·9	[2·2]	5·11	η Argûs, l Leonis	10 28	1 46·34	0·097	0·09
„ 7	4	W.	3·2	[2·2]	7·84	δ Muscæ, ε Virginis	12 17	1 48·72	0·092	0·09
„ 10	2	W.E.	3·4	2·0	[7·2]		10 10	1 55·15	0·092	0·09
„ 12	5	E.	2·8	[2·0]	6·71	ρ Leonis, δ^2 Chamæleontis	10 32	1 59·49	0·090	0·09
„ 15	6	E.	3·4	[2·1]	[4·7]		11 49	2 6·61	0·097	0·10
„ 15	3	E.	2·2	[2·1]	[4·7]		21 23	2 7·61	0·105	0·09
„ 16	6	E.W.	3·2	[2·1]	[4·0]		10 27	2 8·55	0·072	0·08
„ 17	5	W.	3·0	[2·1]	3·34	β Chamæleontis, β Hydri	12 13	2 10·97	0·094	0·09
„ 21	3	W.	0·8	[2·2]	[4·4]		12 32	2 20·51	0·099	0·10
29	10	W.E.	3·3	2·4	4·68 8·38	β Chamæleontis, β Hydri, W. κ Octantis, ζ Virginis, E.	13 15	2 37·35	0·087	0·08
„ 31	5	E.	2·1	[2·5]	6·62	l Leonis, δ^2 Chamæleontis	11 10	2 41·14	0·083	0·08

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892			″	″	″		H. M.	M. S.	S.	S.
June 3	5	E.	1·2	[2·6]	7·40	β Chamæleontis, β Hydri	11 42	2 47·51	0·088	0·08
„ 4	2	E.	1·3	[2·6]	[7·6]		13 27	2 49·70	0·085	0·08
„ 7	8	E.W.	1·3	2·8	6·00 10·30	η Virginis, α^1 Crucis, E. κ Octantis, ζ Virginis, W.	12 55	2 55·44	0·080	0·08
7	4	W.	1·4	[2·8]	[8·0]		17 53	2 55·68	0·048	0·05
„ 9	8	W E.	1·8	3·0	7·51 7·49 5·47	η Virginis, α^1 Crucis, W. δ Muscæ, ε Virginis, E. κ Octantis, ζ Virginis, E.	12 35	2 59·26	0·084	0·09
„ 11	2	E.	1·1	[3·0]	[6·8]		14 54	3 4·20	0·098	0·09
„ 18	2	E.	1·4	[2·8]	[6·8]		16 0	3 18 82	0·087	0·09
„ 25	1	E.	[0·6]	[2·7]	[6·8]		7 8	3 35·14	0·097	0·10
„ 25	2	E.	0·6	[2·7]	[6·8]		13 28	3 35·77	0·100	0·10
July 7	10	E.W.	0·2	2·4	6·14 7·41	κ Octantis, ζ Virginis, E. d Bootis, δ Octantis, W.	14 5	4 4·16	0·098	0·10
„ 8	4	W.	1·5	[2·4]	4·71	ρ Octantis, ε Serpentis	15 36	4 6·61	0·096	0·09
„ 11	6	W.	2·2	[2·2]	4·54	ρ Octantis, ε Serpentis	15 13	4 14·53	0·083	
„ 17	6	W.	3·0	[2·0]	5·16	δ^1 Apodis, δ Ophiuchi	15 43	4 12·03		
„ 18	8	W.E.	0·8	2·0	6·21	ρ Octantis, α Serpentis, E.	14 1	4 13·03	0·045	0·06
„ 19	4	E.	0·5	[2·2]	[5·9]		17 23	4 14·99	0·072	0·07
„ 20	4	E.	0·3	[2·3]	5·59	ε Serpentis, δ^1 Apodis	16 5	4 16·54	0·068	0·07
„ 21	4	E.	0·5	[2·4]	8·67	δ Ophiuchi, γ Apodis	16 13	4 18·30	0·073	0·09
			−	+	−					
„ 22	6	E.W.	0·2	2·6	5·85 7·57	ζ Virginis, θ Apodis, E. δ Ophiuchi, γ Apodis, W.	14 56	4 20·68	0·105	0·09
			+	+	−					
„ 23	8	W.	0·2	[2·3]	[6·3]		16 57	4 22·87	0·084	0·07

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892.			″	″	″		H. M.	M. S.	S.	S.
July 24	5	W.	0·2	[2·1]	6·47 5·17	ζ Virginis, θ Apodis α Tri. Aust., κ Ophiuchi	14 18	4 24·17	0·061	0·07
„ 25	6	W.	1·4	[1·8]	3·35 5·27	ρ Octantis, α Serpentis δ^1 Apodis, δ Ophiuchi	15 54	4 26·02	0·072	0·07
„ 27	3	W.	1·2	[1·3]	4·94	α Serpentis, δ^1 Apodis	15 55	4 29·88	0·080	0·07
„ 28	7	W.E.	1·3	1·0	5·19 7·36 8·90	δ^1 Apodis, β Herculis, W. γ Apodis, β Herculis, W. α Tri. Aust., κ Ophiuchi, E.	16 42	4 31·40	0·061	0·06
„ 29	7	E.	1.0	[1·2]	6·42 6·55	ϵ Serpentis, δ^1 Apodis α Tri. Aust., κ Ophiuchi	16 10	4 32·93	0·065	0·07
„ 31	8	E.	1·1	[1·7]	[6·1]		15 55	4 36·72	0·079	0·09
Aug. 1	2	E.	0·9	[1·9]	[5·9]		17 44	4 39·05	0·090	0·08
„ 2	7	E.	1·0	[2·2]	5·12 6·22	ϵ Serpentis, δ^1 Apodis α Tri. Aust., κ Ophiuchi	16 14	4 40·81	0·078	0·07
„ 3	7	E.W.	1·7	2·4	5·57 8·38	δ^1 Apodis, δ Ophiuchi, E. α Tri. Aust., κ Ophiuchi, W,	16 24	4 42·19	0·057	0·09
„ 3	4	W.	1·0	[2·3]	4·62	ι Piscium, γ^1Octantis	23 32	4 42·94	0·105	0·09
„ 4	10	W.	1·3	[2·0]	6·73 8·25	δ^1 Apodis, δ Ophiuchi α Tri. Aust., κ Ophiuchi	16 16	4 44·04	0·066	0·07
			−	+	−					
„ 5	10	W.E.	0·2	1·6	6·86 7·81	η Serpentis, ζ Pavonis, E. σ Octantis, E.	17 54	4 46·19	0·084	0·08
			+	+	−					
„ 9	4	E.	1·0	[1·6]	7·32	σ Octantis	18 30	4 53·91	0·080	0·08
„ 10	7	E.	1·4	[1·6]	4·34	σ Octantis	18 4	4 55·74	0·078	0·08
„ 11	5	E.	1·2	[1·6]	5·85	α Tri. Aust., κ Ophiuchi	16 54	4 57·75	0·088	0·09

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892.			″	″	″		H. M.	M. S.	S.	S.
Aug. 14	4	E.	1·5	[1·6]	5·77	ε Serpentis, δ^1 Apodis	15 54	5 5·12	0·104	0·11
„ 15	10	E.W.	1·9	1·6	5·39 5·97	η Serpentis, ζ Pavonis, E. σ Octantis, W.	18 48	5 8·28	0·118	0·11
„ 18	2	W.	1·6	[1·6]	7·36	σ Octantis	19 7	5 15·61	0·101	0·10
„ 20	3	W.	1·5	[1·6]	[4·4]		18 20	5 20·29	0·099	0·09
„ 23	4	W.	1·8	[1·6]	0·01	Achernar, o Piscium	1 47	5 27·15	0·086	0·08
„ 24	7	W.E.	3·0	1·6	6·31 7·33	η Serpentis, ζ Pavonis, E. σ Octantis, E.	18 11	5 28·43	0·078	0·08
„ 25	4	E.	2·2	[1·8]	6·21	ε Serpentis, δ^1 Apodis	15 55	5 30·21	0·082	0·08
„ 26	3	E.	2·0	[1·9]	[6·5]		1 17	5 32·64	0·073	0·08
„ 27	4	E.	2·1	[2·1]	[6·8]		19 14	5 34·31	0·094	0·10
„ 29	2	E.	1·2	[2·4]	[7·4]		19 21	5 39·32	0·104	0·10
Sept. 1	10	E.W.	3·7	2·8	9·28 7·17 8·60	γ Draconis, γ^2 Sagittarii, W. η Serpentis, ζ Pavonis, W. σ Octantis, W.	17 44	5 46·42	0·101	0·10
„ 1	5	W.	3·8	[2·8]	8·76	ε Piscium, κ Tucanæ	0 56	5 47·13	0·099	0·10
„ 4	6	W.	4·3	[2·5]	6·05	γ Draconis, γ^2 Sagittarii	17 33	5 53 14	0·093	0·11
„ 4	6	W.	3·8	[2·5]	5·81	ι Piscium, γ^1 Octantis	23 33	5 53·83	0·115	0·11
„ 8	8	W.E.	3·3	2·0	5·08	η Serpentis, ζ Pavonis, W.	18 40	6 2·33	0·093	0·10
„ 11	5	E.	2·4	[1·9]	5·64 7·37	η Serpentis, ζ Pavonis σ Octantis	18 51	6 9·43	0·098	0·10
„ 16	5	E.	2·9	[1·6]	[5·6]		19 18	6 20·88	0·096	0.11
„ 17	8	E.W.	2·7	1·6	5·41	γ Aquilæ, ε Pavonis, E.	19 55	6 23·60	0·111	0·11
„ 18	5	W.	3·3	[1·7]	5·27	σ Octantis	18 56	6 26·03	0·106	0·11
„ 20	2	W.	3·0	[1·9]	[5·1]		19 50	6 31·73	0·117	0·11
„ 22	6	W.	4·7	[2·0]	4·94	Altair, ε Pavonis	19 35	6 36·46	0.099	0·10

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892.			"	"	"		H. M.	M. S.	S.	S.
Sept. 24	10	W.E.	2·8 9·8	2·2	5·82	Altair, ε Pavonis.	20 35	6 41·23	0·097	0·08
„ 25	7	E.	11·6	[1·6]	5·04 4·56	ε Delphini, β Pavonis β Aquarii, λ^1 Octantis	20 26	6 43·08	0·078	0·09
„ 26	12	E.W.	12·7	1·0	5·69 1·52	ε Delphini, β Pavonis, E. β Aquarii, λ^1 Octantis, W.	20 29	6 45·48	0·100	0·13
„ 27	8	W.	12·6	[1·0]	6 03 5·11 3·10	σ Octantis ε Delphini, β Pavonis β Aquarii, λ^1 Octantis	20 43	6 49·13	0·151	0·14
„ 30	2	W.	12·3	[1·0]	4·75	ε Delphini, β Pavonis	20 16	6 57·71	0·120	0·10
Oct. 1	6	W.	13·3	[1·0]	1·76	β Aquarii, λ^1 Octantis	21 26	7 0·19	0·099	0·09
„ 2	10	W.E.	12·0	1·0	3·43 7·73	Altair, ε Pavonis, W. η Aquarii, β Octantis, E.	20 55	7 2·14	0·083	0·09
„ 3	6	E.	11·0	[1·2]	5·27	β Aquarii, λ^1 Octantis	21 13	7 4·44	0·095	0·09
„ 4	3	E.	12·7	[1·4]	5·67	Altair, ε Pavonis	19 48	7 6·41	0 087	0·09
„ 8	3	E.	12·2	[2·2]	[5·7]		21 28	7 15·17	0·090	0·09
„ 12	8	E.W.	16·7 2·4	3·0	5·12 5·34 6·86	β Aquarii, λ^1 Octantis, E. α Aquarii, υ Octantis, E. η Aquarii, β Octantis, W.	22 5	7 24·10	0·092	0·09
			−	+	−					
„ 30	8	W.E.	0·5	1·6	8·86 7·12	β Aquarii, λ^1 Octantis, W. π Aquarii, β Octantis, E.	22 25	8 5·72	0·096	0·08
„ 31	2	E.	0·4	[1·7]	7·13	α Aquarii, υ Octantis	22 38	8 7·51	0·074	0·08
			+	+	−					
Nov. 4	6	E.	0·9	[1·9]	4·53	γ^1 Octantis, ω Piscium	0 3	8 16·48	0 092	0·08
„ 5	2	E.	2·5	[1·9]	[4·5]		23 12	8 18·29	0 078	0·08

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. −	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892.			"	"	"		H. M.	M. S.	S.	S.
Nov. 13	8	E.W.	1·3	2·4	3·83 4·14	ι Piscium, γ^1 Octantis, E. ι Ceti, β Hydri, W.	23 49	8 36·57	0·095	0·08
„ 14	4	W.	0·7	[2·3]	4·16	η Aquarii, β Octantis	22 47	8 38 32	0·076	0·09
„ 15	5	W.	0·3	[2·3]	3·95	η Aquarii, β Octantis	23 3	8 40·90	0·106	0·10
			+	+	−					
„ 17	6	W.	1·3	[2·1]	2·92	γ^1 Octantis, ω Piscium	23 39	8 44·62	0 077	0·09
„ 18	3	W.	0·4	[2·1]	[4·0]		23 33	8 47 03	0·101	0·09
„ 19	7	W.E.	1·1	2·0	5·09	γ^1 Octantis, ω Piscium	23 31	8 48·80	0·074	0·08
„ 20	1	E.	2·9	[2·1]	[4·7]		1 0	8 50·91	0·083	0·08
„ 22	5	E.	1·4	[2·3]	3·80	θ Piscium, γ^1 Octantis	23 11	8 55·03	0·089	0·10
„ 23	3	E.	1·8	[2·4]	[3·5]		3 3	8 57·99	0·106	0·11
„ 24	4	E.	1·6	[2·5]	[3·1]		0 52	9 0·63	0·121	0·12
„ 25	6	E.W.	1·6	2·6	2·81	γ^1 Octantis, ω Piscium, E.	0 22	9 3·35	0·116	0·12
„ 26	1	W.	2·4	[2·5]	[3·5]		0 47	9 6·30	0·121	0·12
„ 28	1	W.	2·5	[2·2]	[4·2]		1 35	9 12·42	0·125	0·10
„ 29	2	W.	2·4	[2·1]	[5·6]		1 25	9 14·56	0·090	0·09
			−	+	−					
Dec. 3	6	W.E.	0·1	1·6	8·45	ξ^1 Ceti, δ Hydri, E.	2 1	9 20·98	0·067	0·08
			+	+	−					
„ 4	3	E.	0·5	[1·6]	6·40	κ Tucanæ, π Piscium	1 27	9 23·08	0·090	0·09
„ 7	5	E.	4·5	[1·5]	3·40	ι Hydri, ε Eridani	3 15	9 29·91	0·093	0·09
„ 8	4	E.	3·8	[1·4]	3·48	γ Pegasi, β Hydri	0 11	9 31·86	0·093	0·10
„ 9	5	E.	2·1	[1·4]	1·61	γ Pegasi, β Hydri	0 28	9 34·23	0·098	0·12
„ 10	8	E.W.	2·0	1·4	3·78 4·57	γ Pegasi, β Hydri, E. ε Piscium, κ Tucanæ, W.	0 55	9 37·58	0·137	0·14
„ 11	5	W.	2·1	[1·3]	[2·7]		1 8	9 40·96	0·140	0·14

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1892.			"	"	"		H. M.	M. S.	S.	S.
Dec. 12	6	W.	2·3	[1·1]	1·28	γ Pegasi, β Hydri	0 36	9 44·12	0·135	0·15
„ 13	5	W.	3·1	[1·0]	2·15 5·67	β Hydri, δ Piscium ϵ Piscium, κ Tucanæ	1 0	9 48·16	0·166	0·15
„ 14	5	W.	1·5	[0·8]	4·32	ϵ Piscium, κ Tucanæ	1 17	9 51·37	0·132	0·13
„ 15	5	W.	1·6	[0·7]	4·38	ϵ Piscium, κ Tucanæ	1 17	9 54·56	0·133	0·14
„ 18	1	W.	0·8	[0·3]	[4·7]		3 38	10 7·11	0·169	0·16
„ 20	7	W.E.	0·7	0·0	4·92	α Ceti, ι Hydri, W.	3 46	10 14·13	0·146	0·13
„ 21	7	E.	1 3	[0·3]	2·79	ξ^1 Ceti, δ Hydri	1 48	10 16·72	0·118	0·11
„ 22	7	E.	2·0	[0·6]	3·31 2·03	ξ^1 Ceti, δ Hydri μ Hydri, γ Ceti	2 41	10 19·20	0·100	0·10
„ 23	6	E.	1·9	[1·0]	0·32	ξ^2 Ceti, μ Hydri	3 13	10 21·61	0·098	0·10
„ 24	8	E.	1·5	[1·3]	0 58	ξ^2 Ceti, μ Hydri	1 58	10 23·72	0 093	0·09
„ 25	9	E.W.	3·4	1·6	5·07 1·54	ξ^1 Ceti, δ Hydri, W. μ Hydri, α Ceti, W.	2 9	10 25·96	0·093	0·10
„ 29	5	W.	1·6	[0·7]	3·21	θ Hydræ, β Argûs	8 59	10 36·80	0·105	0·09
„ 31	10	W.E.	0·6	0·2	2·14 5·62	ξ^1 Ceti, δ Hydri, W. ι Hydri, f Tauri, E.	2 43	10 40·11	0·079	0·08

NOTES.

1892.

MARCH 27.—No observations could be made with the clamp west.

APRIL 24.—Owing to the presence of visitors on the evening of the 23rd, the chronometer was omitted to be wound. It stopped just before commencing the usual transit observations on the evening of the 24th. It was immediately wound and started again with a small error.

MAY 10.—No observations could be made with the clamp east.

MAY 16.—No observations could be made for azimuth.

JUNE 25.—Observation in full daylight: the level error was not observed.

JULY 16.—The chronometer was omitted to be wound, and it stopped on the evening of the 17th, while the observer was engaged in fixing the positions of double stars with the equatorial. It was instantly wound and restarted.

SEPTEMBER 24.—Owing to a derangement in the reversing apparatus, the transit instrument in the act of reversal fell about half an inch into the segmental bearings, and the shock produced a change of 7" in the level error, but had no sensible effect on the azimuth.

OCTOBER 12.—The eastern pivot was raised during the observations.

Extra-Meridian Work.

ALTHOUGH the year 1892 was characterised by a very large proportion of cloudy nights, an unusually large amount of good work was done in this department. It is as follows :—

OCCULTATIONS OF STARS BY THE MOON.—Observations of these phenomena were made with the 8 and 4½-inch equatorials comprising twenty-six disappearances at the dark and six at the bright limb, and six reappearances at the dark and seven at the bright limb, altogether forty-five phases. All the stars with the exception of one were identified from equatorial observations at the time, and nearly all of them are to be found in modern catalogues. Eleven of the stars in the occultation list of the *Nautical Almanac,* were observed in both phases. The observations have been forwarded to the *Astronomische Nachrichten*. Last year's work brings the total number of occultation phases observed here during the period 1864-92 up to 534, namely, 494 disappearances and 40 reappearances. It may be added that care is always taken to secure a group of star-transits for time as near as possible to the observation of an occultation.

PHENOMENA OF JUPITER'S SATELLITES.—The 8-inch equatorial was usually employed in observing these phenomena, but in consequence of the unusually heavy work in the comet department few observations have been secured. They are as follows :—Transit ingress—I.1, II.1, III.1; Transit egress—I.2, III.1; Occultation disappearances, II.1, III.1; Occultation reappearances, III.1; Eclipse reappearances, I.4, II.2. Observations were made on two or three occasions of the phenomena presented by the third satellite in transit across the disc of its primary. These have already appeared in the publications of the Astronomical Society of the Pacific.

CONJUNCTION OF MARS AND IOTA AQUARII.—Twenty good comparisons of the planet and star were obtained shortly after the conjunction by means of the filar micrometer on the 8-inch equatorial, and the results have been published in the *R.A.S. Monthly Notices.*

COMETS.—Four comets have been observed during the year. The Kiel cable message announcing the discovery by Swift of a bright comet on March 6 was received here on the 9th, but the

comet could not be observed till the morning of the 11th, civil time. An excellent set of comparisons was obtained with the 8-inch telescope and filar micrometer. Cloudy weather then intervened, and it was not till the morning of the 22nd that another position could be secured. It was steadily followed from that time till May 3, when it had gone too far north for observation. The comet throughout the period of its visibility could be well seen in a bright field, and admitted of accurate observation. It was observed on March 10, 21, 22, 26, April 9, 10, 11, 12, 13, 14, 15, 16, 22, 23, astronomical time, with the 8-inch, and on April 30, May 1, 2, with the 4½-inch telescope. Altogether 246 comparisons were obtained, the number of comparison stars being 29. The results have long since been published in the *Astronomische Nachrichten*. The second observed comet was the well-known periodical comet of Winnecke. It was found with the 4½-inch equatorial on June 12 in the position assigned to it in Dr. von Haerdtl's ephemeris, but as it was low in the north-west, and therefore favourably situated for northern observers, no observations were then attempted. It passed conjunction with the sun on July 7, and was first observed here on July 17 as a morning object, and was well followed till September 27. The astronomical dates of observation are July 17, 19, 20, 21, 22, 23, 24, 27, 28, 29, August 2, 3, 15, 23, 25, 26, 27, September 16. 17, 18, 20, 22, 26, 27. The comparisons were made with the square bar-micrometer in a dark field, the 4½-inch telescope being employed on July 17 and the 8-inch instrument on the other dates. The total number of comparisons is 248, and of the comparison stars 29. The results have recently appeared in the *Astronomische Nachrichten*, the *R.A.S. Monthly Notices*, and the *Journal of the Royal Society of New South Wales*. On November 12 a cable message from London appeared in the colonial newspapers announcing that a comet had been discovered in the constellation Andromeda, and a few days afterwards another appeared to the effect that the comet would be within a million of miles of the earth on November 27. There was no difficulty in finding the object with an ordinary opera-glass, and it was found that both it and the Great Nebula could be embraced in the same field of view. Bearing in mind the startling announcement in the newspapers and the fact that the comet was near the radiant of the Andromeds, the author strongly

suspected that our new visitor might turn out to be a fragment of the lost comet of Biela. The object was accordingly followed till it was barely distinguishable. Observations, rough in their character, were secured on November 13, 15, 18, 19, 20, 22, 23, 24, with the square bar-micrometer on the 4½-inch equatorial, embracing 50 comparisons and 5 comparison stars. The resulting positions have recently appeared in the *Astronomische Nachrichten* and the *Journal of the Royal Society of New South Wales*. It was soon obvious that the comet could have no relation to that of Biela. The fourth comet observed here is that discovered by Brooks on August 28 last. After being well observed in the northern hemisphere it came south and was first seen here on the morning of November 29, civil time. It was well observed till the close of the year with a square bar-micrometer on the 4½ and 8-inch equatorials, the astronomical dates of observation being November 28, 29, December 8, 9, 12, 13, 14, 15, 20, 21, 23, 24, 28, 29, the number of comparisons 177 and the comparison stars 23. It has since been well followed down to June 19, 1893, but these observations will properly be accounted for in the report for that year. It may here be mentioned that in accordance with a request from Professor Krueger, of the Royal Observatory, Kiel, a search was made for Comet Tempel, 1867, II., in the region indicated in Gautier's sweeping ephemeris. The sweep was carefully made on June 19, between 17h. 30m. and 18h. 50m. of R.A. and 25° and 32° of south declination, which well covers the ephemeris positions on the three assumptions of perihelion passage, but although the moon was absent and the sky brilliantly clear no trace could be found of the comet.

DOUBLE STARS.—The following southern double stars were observed with the 8-inch equatorial, and the measures have already been published by the Royal Astronomical Society:—*p* Eridani, *h* 4373, α Crucis, γ Centauri, γ Virginis, β Muscæ, *h* 4634, α Centauri, π Lupi, Lacaille 6477, ρ Ophiuchi, 36 Ophiuchi, Brisbane 6556, and γ Coronæ Australis.

VARIABLE STARS.—A few comparisons of η Argûs and *R*. Carinæ were made with neighbouring stars. It is very much to be regretted that the author's close application to other departments of observation has prevented due attention to these two interesting variables.

Meteorological Observations.

These were made regularly at 9h. a.m. throughout the year, and the rainfall results have been sent to the Government Astronomer for incorporation with similar results obtained at the numerous stations in the colony under his superintendence. Last year is the thirtieth in this department of observation.

Publications.

The following is a list of the papers published by the author in scientific journals, being a continuation of that which appeared in previous reports:—

OBSERVATIONS OF CERES AND OF COMETS, 1891, II. (WOLF), AND 1892, I. (SWIFT).—See Report for 1891, and p. 15 of the present Report. *Astronomische Nachrichten,* Band CXXXI., No. 3123, p. 41; *Journal of the Royal Society of New South Wales*, Vol. XXVI., p. 335.

THE CONJUNCTION OF VENUS AND JUPITER, 1892, FEB. 6 (as a test of the power of unassisted vision).—Cloudy weather prevented the observation of this phenomenon at Windsor, but in response to the author's suggestion it was observed with the naked eye by several persons in New South Wales. The paper embodies the observations thus made, and the conclusion derived from them. *Journai of the British Astronomical Association,* Vol. II., p. 325.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES in 1891.—See Report for 1891, p. 15. *R.A.S. Monthly Notices*, Vol. LII., p. 598.

OBSERVATIONS OF WINNECKE'S COMET in 1892.—See this Report, p. 16. *R.A.S. Monthly Notices*, Vol. LIII., p. 70, and *Astronomische Nachrichten*, Band CXXXI., No. 3144, p. 405. *Journal of the Royal Society of New South Wales,* Vol. XXVI., p. 335.

OBSERVATIONS OF COMET, 1892, III. (HOLMES).—See this Report, p. 16. *Astronomische Nachrichten*, Band CXXXII., No. 3146, p. 25. *Journal of the Royal Society of New South Wales*, Vol. XXVI., p. 332.

PHYSICAL OBSERVATIONS OF JUPITER'S SATELLITES IN TRANSIT.—The following transits were observed:—Sat. II., September 12, 1891; Sat. III., October 2, 1891; Sat. I.,

October 19, 1891; Sat. III., October 30, 1892; Sat. III., December 12, 1892. *Publications of the Astronomical Society of the Pacific*, Vol. V., 1893, No. 28, p. 40.

OBSERVATIONS OF MARS AND ι AQUARII NEAR THEIR CONJUNCTION, 1892, NOVEMBER 4.—See this Report, p. 15. *R.A.S. Monthly Notices*, Vol. LIII., p. 341.

τ^1 ARIETIS—IS IT SINGLE, DOUBLE, OR TRIPLE?—This communication furnishes extraordinary phenomena observed during the occultation of this star at the moon's dark limb, at Windsor, on January 26, 1893, which point strongly to the probable triple character of the star. *Journal of the British Astronomical Association*, Vol. III., No. 4, p. 187.

RESULTS OF DOUBLE STAR MEASURES AT WINDSOR, N.S.W., in 1892. *R.A.S. Monthly Notices,* Vol. LIII., p. 369.

The Library.

This important department of the Observatory continues to be enriched by presents from various scientific institutions and individuals. A list of all the presents during the year is presented at the close of this Report with the best acknowledgments of the proprietor. It will, perhaps, be again advisable to notify correspondents and donors of publications that the author's complete address is "The Observatory, the Peninsula, Windsor, New South Wales, Australia." It is particularly requested that the name of the Colony may be given in the address, inasmuch as Australia is a term which embraces several "Colonies" and several "Windsors."

Personal Establishment.

This remains the same as in former years. All the astronomical and nearly all the meteorological observations have been made by the proprietor. During an occasional absence from home, the latter observations have been made by his son. The greater portion of the astronomical reductions has been made by the former. As a computer is not permanently engaged, he has to avail himself of occasional assistance. It is, however, difficult to get the occasional services of a quick and accurate computer. Mr. Murray L. Allen, of Collector, has been engaged in the calculation of star reductions, parallax factors, and sundry

other data; but check calculations of these results have been made by different forms by the author himself. Those calculations which are not done in duplicate are usually made according to forms, which are themselves in their nature self-checking. The meteorological sums and means have been calculated by the author's son, and also by Mr. Victor Mayers. The latter has also been employed in some other reductions which required the use of natural numbers only. Every precaution has been taken to make both the observations and their reductions as trustworthy as possible. The author has again to acknowledge the volunteer services of Mr. R. T. A. Innes, of Sydney, F.R.A.S., in providing him with his prediction-calculations of the occultations of *Nautical Almanac* stars.

Observations Recently Utilized.

The Windsor measures of γ Coronæ Australis in 1887, 1888, 1889, 1890 and 1891, and of γ Centauri in 1882, 1887, 1888, and 1890 have recently been employed by Mr. J. E. Gore, F.R.A.S., in redeterminations of the orbits of these interesting binaries. The measures of α Centauri in 1881, 1884, 1885, 1886, 1887, 1888, 1890 and 1891, have also been turned to account by Mr. E. B. Powell, F.R.A.S. in testing the elements published by him in the *Monthly Notices* for April, 1886. See *R.A.S. Monthly Notices,* Vol. LII., pp. 503 to 508. The measures of γ Coronæ Australis have also been availed of by Mr. R. P. Sellors, B.A., of the Sydney Observatory, in a more recent investigation of the orbit of this star. See *R.A.S. Monthly Notices,* Vol. LIII., p. 45. In Dr. Friedrich Hayn's elaborate memoir "Bahnbestimmung des Cometen, 1862, III.," published in 1889, but only recently received, the Windsor observations of that celebrated comet are fully discussed. This circumstance is peculiarly interesting in the history of the Observatory, because the observations referred to were made under great difficulties, and were the first ever published by the author in the astronomical journals of the northern hemisphere. The older of the two observatories had not been erected at the time, and the differential measures of the comet and stars of comparison, were made by means of a ring-micrometer adapted to the old 3½-inch refractor, which was itself mounted on a tripod in the open air, and without divided circles of any kind. The time keeper was a

common, but excellent eight-day hall clock with seconds pendulum; it was regulated from sextant observations, and its beats were just audible at the telescope. See "History and Description of the Observatory," pp. 5, 20, 38, and 40. The comparison stars were identified by observing their transits across the field of the telescope in connection with other stars plainly visible to the naked eye, these latter being themselves identified by sextant observations taken on the same evening. In Dr. Hayn's investigation, the residuals have turned out as satisfactory as can be expected under the circumstances thus detailed. The greatest divergences from the provisional orbit are almost wholly in the declination results, a circumstance which might be expected from the use of a simple ring-micrometer. The Windsor telescope was, moreover, the smallest employed at the twenty-seven stations from which the comet was observed. The Windsor observations of Comet, 1886, II., have just been utilized by Pfarrer A. Thraen in his "Definitive Bahnbestimmung des Cometen, 1886. II." in *Astronomische Nachrichten,* Nos. 3160 and 3161. The observations were made with a square bar-micrometer on the 4½-inch equatorial, and have turned out equal to those made with much larger instrumental means. The fifteen Windsor positions originally published have, without a single rejection, been accepted for the final correction of the orbit.

Work Proposed for the Year 1893.

The main work of the Observatory consists of the observations of lunar occultations of stars, southern comets and the meteorological instruments, and these three objects will be kept steadily in view. Many suggestions have been received from eminent astronomers as to work desirable to be done, but the author much regrets that he is unable to comply with them. Indeed, the time is at hand, when he will have to seek some relaxation, for the work during the past few years has been sufficient to tax his powers to the utmost. In due time, however, he trusts to take up the work again with renewed energy.

July 1st, 1893.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1892.

[NOTE.—The Names of the Donors are printed in Italics.]

Description of the Star Camera at the Sydney Observatory, pp. 12, with plates.
Results of Double Star Measures at Sydney Observatory, pp. 22.
Preparations now being made in Sydney Observatory for the Photographic Chart of the Heavens, by H. C. Russell, B.A., etc., pp. 10, with plates.
Results of Meteorological Observations in N. S. Wales, during 1889, pp. VIII., 148, with maps.
Meteorological Observations in N. S. Wales, 1880, 1881, 1882.
Meteorological Observations in N. S. Wales, 1883, 1884.
Results of Rain, River and Evaporation Observations in N. S. Wales, during 1890, pp. 174, with maps, two copies.
Cyclonic Storm or Tornado in the Gwyder District, by H. C. Russell, B.A., etc., pp. 3.
Note on the Rate of Growth of some Australian Trees, by H. C. Russell, B.A., etc., pp. 4.
Physical Geography and Climate of N. S. Wales, by H. C. Russell, B.A., etc., 2nd Ed. pp. 35, with maps and two diagrams.
The Government Observatory, Sydney.

Monthly Record of Results of Observations in Meteorology, Terrestrial Magnetism, etc., at the Melbourne Observatory, etc., from September, 1891, to June, 1892, both inclusive.
The Government Observatory, Melbourne.

Meteorological Observations at Adelaide Observatory and other places in South Australia, etc., in 1889.
Monthly Rainfall Returns for South Australia, from October, 1891, to August, 1892, both inclusive.
The Government Observatory, Adelaide.

Standard Weather Chart of Australasia and Surrounding Regions, for 1892, March 28, 9 h. a.m.
The Government Weather Bureau, Brisbane.

Monthly Record of Meteorological Observations at Hobart, etc., for 1891, November and December.
The Government Meteorological Observatory, Hobart.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, Vol. VII., Parts I. and II.
The Queensland Branch of the R. Geograph. Society of Australasia.

The Surveyor for 1892. Complete in Monthly Parts.
The Institution of Surveyors, New South Wales.

Report of the Trustees of the Free Public Library, Sydney, for 1891, pp. 15. *The Free Public Library, Sydney.*

Astronomical Explanation of a Glacial Period, by Sir R. Ball, Section A., Hobart, January 8, 1892, pp. 8, two copies.
Remarks on the above Paper, by A. B. Biggs, pp. 5.
Report of Committee No. 1, Seismological Phenomena in Australasia, pp. 33.
On the Proposed "Leake" School of Practical Astronomy, by H. C. Russell, F.R.S., etc., pp. 6.
On the Application of Photography to Geological Work, by J. H. Harvey, Section C., pp. 2.
On the Presence of Magnetite in certain Minerals and Rocks, by A. Liversidge, M.A., etc., pp. 8.
On Iron Rust Possessing Magnetic Properties, by A. Liversidge, M.A., etc., pp. 18.
The Aust. Association for the Advancement of Science, Hobart.

Results of Astronomical and Meteorological Observations at Radcliffe Observatory in 1887, Vol. XLV., pp. XX., 112, XIII., 131.
The Radcliffe Trustees.

Second Glasgow Catalogue of 2156 Stars for 1890, by R. Grant, M.A., etc., pp. XXXVI., 182. *The Glasgow Observatory.*

Weekly Weather Reports from January 10 to July 15, 1891, and Quarterly Summary.
Weekly Weather Reports from August 1, 1891, to January 2, 1892, with Monthly Summaries for 1891.
Monthly Weather Reports, May to December, 1887.
Quarterly Weather Reports, Part III., July-September, 1880, and Part IV., October-December, 1880.
Hourly Means of the Readings, etc., at Four Stations under the Meteorological Council, 1887.
Hourly Means at the Four Observatories under the Meteorological Council, 1888, pp. 112.
Report of the Meteorological Council to the Royal Society for the year ending March 31, 1891, pp. 106.
Meteorological Observations at Stations of the Second Order for 1887.
Harmonic Analysis of Hourly Observations of Air Temperature and Pressure at British Observatories, pp. 92.
Ten Years' Sunshine in the British Isles, 1881-1890, pp. 58, with maps.
The Meteorological Office, London.

Report of the Kew Committee for the Fourteen Months ending December 31, 1891, pp. 34. *The Kew Observatory.*

Results of the Meteorological and Magnetical Observations at Stonyhurst College Observatory for 1891, pp. 73.
The Stonyhurst College Observatory.

Report on the Temple Observatory, Rugby, for 1891, pp. 2.
The Temple Observatory.

Lunar Radiant Heat, measured at Birr Castle Observatory during the Total Eclipse of January 28, 1888, by Otto Boeddicker, (Ph.D.,) pp. 17, with diagrams.
Birr Castle Observatory, Parsonstown.

Report of Wolsingham Observatory for 1891, pp. 2.

The Wolsingham Observatory.

Results of Observations of the Fixed Stars with the Meridian Circle at the Government Observatory, Madras, in 1871, 1872 and 1873, pp. XIX., 266, and in 1874, 1875 and 1876, pp. XXIII., 168.

Results of Meteorological Observations at Madras, 1861-1890, pp. 394.

The Government Observatory, Madras.

The Monthly Weather Review from August, 1891, to July, 1892, both inclusive.

Toronto General Meteorological Register for 1891.

Report of the Meteorological Service of the Dominion of Canada, by C. Carpmael, M.A., &c., for 1888, pp. XLIV., 293.

The Meteorological Office, Toronto.

Report of the U.S.N. Observatory for the year ending June 30, 1891, pp. 18.

Observations made at the U.S.N. Observatory, Washington, during 1886, pp. XCIX., 221 and 100, with plates; also during 1887, pp. LXXXV., 170, with three Appendices, pp. 37, 99, 261, and 10 plates.

Meteorological Observations and Results at the U.S.N. Observatory, 1883-1887, pp. 261.

A Report upon some of the Magnetic Observatories of Europe, by C. C. March, U.S.N., pp. 37, with 6 plates.

Magnetic Observations at the U.S.N. Observatory in 1890, by J. A. Hoogewerff, U.S.N., pp. 99, with 4 plates.

Magnetic Disturbances, 75th Meridian, M.T., from January to May, 1892; sheet.

Astronomical Papers for the use of the American Ephemeris and Nautical Almanac, comprising Vol. II., Part VI.; the N.P. Distances of the Greenwich and Washington Transit Circles, and the Constant of Nutation, by Prof. S. Newcomb, p. 407 to 490, two copies; Vol. III., Part V., Periodic Perturbations of the Four Inner Planets, by S. Newcomb, p. 391 to p. 574, two copies.

The U.S.N. Observatory, Washington.

The American Ephemeris and Nautical Almanac for 1894, 1st. Ed. pp. 532.

Office of the American Ephemeris.

Reports on the Observations of the Total Eclipse of the Sun, Dec. 21-22, 1889, and of the Total Eclipse of the Moon, July 22, 1888, pp. 121, with plates, and Catalogue of the Library of the Lick Observatory, part I. to July 1, 1890, pp. 121. *The Lick Observatory.*

Bulletin of the Franklin Institute for Nov., Dec., 1891, Jan., March, April, May, Sept., Oct., 1892.

The Port of Philadelphia, by Prof. L. M. Haupt, C.E., pp. 23.

The United States Life-Saving Service, by H. L. Piper, pp. 22.

Joves' Autograph, by W. N. Jennings, pp. 8, with plates.

Bearing Metal Alloys, by C. B. Dudley, Ph.D., pp. 28.

Philadelphia as a Seaport, by Capt. F. A. Mahan, pp. 34.

Aluminium—Its Manufacture and Uses from an Engineering Standpoint, by A. E. Hunt, C.E., pp. 31.
Annual Report of the Director of the Drawing School of the Franklin Institute for 1891-92, pp. 2.
List of Duplicates recently added to the Library of the Franklin Institute, pp. 8.
A Practical Consideration of Compressed Air, by W. L. Saunders, C.E., pp. 24, with diagram.
Eyesight in Middle Life and Old Age, with hints for its care, &c., by L. W. Fox, M.D., pp. 16.
Notes on the Blast Furnace, by J. M. Hartman, pp. 14, with plates.
A Motor without Fuel, and the Second Principle of Thermo Dynamics, by Dr. H. Mahner, pp. 20.
The Present Status of the Storage Battery System of Street Railway Propulsion, by P. G. Salom, pp. 10.
Oleomargarin, by Prof. G. C. Caldwell, pp. 30.

The Franklin Institute, Philadelphia.

Report of the Yale University Observatory for 1891-92, pp. 26.

Yale University Observatory.

The Californian Illustrated Magazine for April, 1892.

The Academy of Sciences, San Francisco.

Photograph of the Equatorial of the Warner Observatory.

The Warner Observatory, U.S.A.

Rapport Annuel sur l'Etat de l'Observatoire de Paris pour 1891, pp. 39.

The Paris Observatory.

Relations des Phénomènes Meteorologiques deduites de leur variations diurnes et annuelles, par Ch. André, pp. 168, including 6 plates.
Meteorologie Lyonnaise par Ch. André, 1887-88, pp. 75, 1888-89, pp. 81, et 1889-90, pp. 85.
Recherches sur l'Equation Personnelle, par M. F. Gonnessiat, pp. 167.

The Observatory, Lyons.

Der Brorsen'sche Comet, I. Theil, Die Verbindung der Erscheinungen, 1873, und 1879, und die Vorausberechnung für 1890, von Prof. Dr. E. Lamp, pp. 68.

The Royal Observatory, Kiel,

Göttinger Stern-Catalog für 1860, nach Beobachtungen von Klinkerfues. pp. XXVIII., 77.

The Royal Observatory Göttingen.

Magnetische und Meteorologische Beobachtungen an der k. k. Sternwarte zu Prag im Jahre, 1891, pp. XVI., 41.

The Observatory, Prague.

Meteorologische Beobachtungen angestellt am Haynald-Observatorium zu Kalocsa, 1886-88, pp. 142, with diagrams.

Archbishop Haynald's Observatory, Kalocsa.

Publicationen der v'Kuffner'schen Sternwarte in Wien (Ottakring), Band II. und 4 Tafeln. Abth. I., pp. 253; Abth. II., pp. 146.

von Kuffner's Observatory, Vienna.

Recherches sur la Rotation du Soleil, par N. C. Duner, pp. 78, with diagrams.

Om Iakttagelserna vid Upsala Observatorium für Equinoktiats Bestämning våren och Hösten, 1889, af K. Bohlin och C. A. Schultz-Steinheil, pp. 58.

Definitive Bahn-Elemente des Kometen, 1840, IV., von. C. A. Schultz-Steinheil, pp. 28.

The Upsal Observatory.

Bestämningar af polhöjden för observatorium i Helsingfors, af A. Donner, pp. 84.

Walbeck's Abhandlung "De Forma et magnitudine telluris," pp. 12.

The Observatory, Helsingfors.

Meteorologische Beobachtungen angestellt in Dorpat, 1890, pp. 64, und 1891, pp. 64.

Bericht über die Ergebnisse der Beobachtungen an der Regenstationen etc., für 1889, 1890 und 1891, pp. 34.

The Meteorological Observatory, Dorpat.

Observations faites au Cercle Meridien à l'Observatoire de Varsovie par I. Wostokoff. Partie I., pp. VIII., 322.

The University Observatory, Warsaw.

Annales de l'Observatoire de Kiew. Vol. III., pp. 237.

The Observatory, Kiew.

Osservazioni Meterologiche fatte nell'anno 1890, all'Osservatorio della R. Università di Torino, pp. 53.

Di un Notevole Tipo Isobarico Subalpino nota del Dott. G. B. Rizzo, pp. 16, with plates.

Variazioni prodotte dal Calore in alcuni Spettri d'Assorbimento nota del Dott, G. B. Rizzo, pp. 9, with plates.

Azimut Assoluto del Seguale Trigonometrico di Monte Vesco su'll'orrizonte di Torino determinato negli anni 1890 e 1891 da F. Porro, pp. 52.

Effemeridi del Sole e della Luna per l'orrizonte di Torino, 1892, T. Aschieri, pp. 16.

The Observatory, Turin.

R. Osservatorio Astronomico di Brera in Milano, Osservazioni Meteorologiche, 1891.

The Observatory, Milan.

Sulla Constante della Collimazioné del Cerchio Meridiano Reichenbach-Heurteux del R. Osservatorio di Capodimonte, del Dott. F. Contarino, pp. 8.

Determinazioni Assolute della Componente Orrizontale della Forza Magnetica Terrestre fatte nel R. Osservatorio di Capodimonte nell'anno 1889, del Dott. F. Contarino, p. 11.

Determinazioni Assolute della Inclinazione Magnetica nel R. Osservatorio di Capodimonte, 1889-90-91, nota del Dottor F. Angelitti, pp. 6.

Riassunti Decadici e Mensili delle Osservazioni Meteoriche fatte nel R. Osservatorio di Capodimonte, 1889 and 1890, del Dr. F. Contarino, pp. 6 and 6.

Determinazioni Assolute della Declinazioné Magnetica nel R. Osservatorio di Capodimonte, 1890, del Dr. F. Angelitti, pp 5.

Sull'errore di Collimazione negli strumenti Meridiani nota del E. Fergola, pp. 4.

Osservazioni Meteoriche fatte nel R. Osservatorio di Capodimonte, 1889-90-91.

Posizioni Apparenti di alcune stella dell'Eridano osservate nel R. Osservatorio di Capodimonte, E. Fergola, pp. 7.

The Observatory, Capodimonte, Naples.

Die Triangulation von Java, Dritte Abtheilung, von Dr. J. A. C. Oudemans, pp. 180, with maps and diagrams.

The Netherlands Government.

Revista do Observatorio do Rio de Janeiro, 1891, Outubro, Novembro, 1892, Janeiro.

The Imperial Observatory, Rio de Janeiro.

Anuario del Observatorio Astronomico Nacional de Tacubaya, 1892, pp. 391.

Boletin del Observatorio Astronomico Nacional de Tacubaya, Tomo I., No. 7, 8, 9, 10, 11.

The Observatory, Tacubaya.

Anuario del Observatorio de la Plata para el ano 1892, pp. 148.

The Observatory, La Plata.

Annual Report of the Central Meteorological Observatory, Tokio, Japan, for 1890, parts I. and II.

The Observatory, Tokio, Japan.

Meteorological Observations at Rousdon Observatory, Devon, for 1891, by C. E. Peek, M.A., etc., pp. 31 (two copies).

The Author.

The Problem of Probable Error as applied to Meteorology, by T. W. Backhouse, pp. 5.

The Author.

On the Application of Measuring Rods to Photographic Pictures, by J. Sidebotham.

On Celestial Photography, by A. Brothers, F.R.A.S.

Remarks on the Barometric Disturbances during October, November and December, 1865, by Mr. Vernon.

Note on the Variable Star T Aquilæ, by Mr. Baxendell, F.R.A.S., being Extracts from the Proceedings of the Manchester Literary and Philosophical Society, Vol. V., No. 8, Session 1865-66.

Observations of Comet I., 1861, by Joseph Baxendell, F.R.A.S., pp. 4.

Observations of the New Variable Star T. Coronæ, by same, pp. 6.
Observations of the Meteoric Shower of November 13-14, 1866, by same, pp. 4.
On the Relations between the Decrement of Temperature on Ascending in the Atmosphere and other Meteorological Elements, by same, pp. 14.
On a Diurnal Inequality in the Direction and Velocity of the Wind, etc., by same, pp. 9.
On Observations of Atmospheric Ozone, by same, pp. 12.
Observations of Dr. Klein's New Lunar Crater near Hyginus, at Birkdale, by same, pp. 11.
Abstract of Results of Meteorological Observations, Borough of Southport, for 1891, by J. Baxendell, pp. 11.

Joseph Baxendell.

Remarks on Sir Robert Ball's Paper, entitled "The Astronomical Explanation of a Glacial Period," by A. B. Biggs.

The Author.

Histoire de l'Astronomie a Toulouse de l'origine à la Fondation de
G l'observatoire actuel, par M. ~~K~~. Bigourdan, pp. 46, with plate.

The Author.

Monographie de l'Observatoire de Nice, par C. Garnier, with 36 large plates.

R. Bischoffscheim, Membre de l'Institut de France.

On the Reappearance of Saturn's Ring, by the Rev. A. Freeman, pp. 4.
On the Illumination of Saturn's Rings during Sunrise, and on Recent Observations of their Reappearance, by Rev. A. Freeman, M.A., pp. 7.

The Author.

Bulletin de la Societé Oceannienne, Tome I., 1892, No. 2 (two copies).

John Fraser, B.A.

On Certain Geometrical Operations, Part I., by G. Fleuri, pp. 10, with plate.

The Author.

On the Orbit of γ Coronæ Australis, pp. 2, by J. E. Gore (two copies).
On the Orbit of γ Centauri, by J. E. Gore, pp. 2 (two copies).
On the Orbit of the Binary Star ι Leonis (Σ 1536), by J. E. Gore, M.R.I.A., etc., pp. 4.
The Pleiades, by J. E. Gore, F.R.A.S., etc., pp. 7.
On the Orbit of OΣ 269, by J. E. Gore, p. 1.

The Author.

Address by the President (W. H. Hamlet) to Section B, Chemistry and and Mineralogy, of the Australasian Association for the Advancement of Science, pp. 16.

The Author.

Flying Machine Work and the $\frac{1}{6}$ I.H.P. Steam Motor, weighing $3\frac{1}{4}$ lbs., by L. Hargraves, pp. 6, with 9 plates.

The Author.

Secular Perturbations of the Earth's Orbit by Mars, by R. T. A. Innes, F.R.A.S.

The Author.

Moore's Sixpenny Almanac—1892.

Rev. S. J. Johnson, M.A.

Elementary Principles Governing the Efficiency of Spectroscopes for Astronomical Purposes, by James E. Keeler, pp. 21.
The Star Spectroscope of the Lick Observatory, by J. E. Keeler, pp. 5, with plates.

The Author.

Ephemeris of the Satellites of Neptune, 1891-92, pp. 2, by A. Marth, F.R.A.S.
Ephemeris for Physical Observations of the Moon, 1891, November 9 to December 25, pp. 2, by same.
Ephemeris of the Satellites of Saturn, 1891-92, pp. 10, by same.
On the Conjunction of Venus and Jupiter, 1892, February 5-6, pp. 3, by same.
Ephemerides of the Satellites of Saturn, 1891-92 (continued), by same.
Ephemerides of the Satellites of Saturn, 1891-92 (concluded), pp. 7, by same.
Ephemeris for Physical Observations of Mars, 1892, pp. 7, by same.
Ephemeris of the Satellites of Mars, 1892, pp. 4, by same.
Ephemeris for Physical Observations of Jupiter, 1892, pp. 18, by same.
Note on the Occultation of the Star, 73 Piscium, 6·4 mag. by Jupiter on 1892, May 23, p. 1, by same.

The Author.

Beobachtungen Veränderlicher Sterne, von J. Plassman, Dritter Theil, pp. 23.

The Author.

The Surveyor, for May 7, 1889.

A. O. Powys.

President's Address before the Royal Society of New South Wales, May 4, 1892, pp. 51, by H. C. Russell, B.A., etc.

The Author.

Universal Time Measurement, pp. 11, by J. P. Thomson, F.R.S.G.S., etc.
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The Author

L'Histoire de la Decouverté de la Planète Neptune, par Em. Liais, reproduit par A. Tischner.
Le Mouvement de la Lumière, pp. 11, par A. Tischner.

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Note on Some Specimens of Plants Collected at King George's Sound by Mr. H. Willis, pp. 10. By Rev. W. Woolls, Ph.D., etc.,

The Author.

Le Système du Monde Electro-dynamique, par Prof. Ch. V. Zenger, pp. 24, with plates.

The Author.

Revue Generale des Sciences pures et appliquées, Sept. 5, et Août. 30, 1891.

The Editor.

The Gelatine Bromide Paper Process, Contact Printing, and How to Make Enlargements, pp. 20.

The Publishers.

ERRATA.

In the Report for 1890 :—

Page 8, line 19 from top, *for* 30° *read* 33°.

„ 17 „ 2 „ bottom, *for* parrallax *read* parallax.

In the Report for 1891 :—

Page 6. Feb. 21 and March 13, *insert* E after ζ Geminorum.

„ 6. March 5 „ W „ ζ Geminorum.

„ 7. March 30 and April 7 „ W „ θ Chamæleontis.

„ 7. April 30 „ W „ ζ Chamæleontis.

„ 17. Line 6 from bottom, *insert* Band *before* CXXVIII.

In the Report for 1892 :-

Page 12, Sept 24, *insert* W *after* Σ Pavonis.

„ 13. Nov 9. „ E „ ω Piscium.

„ 29. Line 9 from top, *for* A *read* G.

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University of Michigan

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1893.

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association;
Corresponding Member of the Societé Ethnographique of Paris, and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

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CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY

For 1893.

It will be seen from the Report which follows, that there has been no relaxation in the work of the Observatory during the year 1893. The work done is quite equal in every respect to that of previous years.

Buildings and Instruments.

The proposed enlargement of the circular chamber, accommodating the 8-inch equatorial refractor, is now in progress. The old wooden structure is not only exceedingly inconvenient as regards size, but it will soon become useless in consequence of the inroads of the white ant. A substantial building of brick is now in course of erection, with an internal diameter of eighteen feet. The telescope will be retained in its present position, and the old structure of wood will, of course, be removed as soon as the new building is completed.

Position of the Observatory.

The co-ordinates of the Observatory are as given in the last Report, namely:—Longitude from Greenwich = 10h. 3m. 20·51s. E.; Latitude = $-33° \; 36' \; 30{\cdot}8''$.

Meridian Work.

Throughout the year 1893, the sidereal chronometer, *John Poole*, No. 2962, was employed in connection with the 3-inch transit instrument as the time-keeper of the Observatory. It will be unnecessary to enter here into a description of the methods by which the errors of the transit instrument and the chronometer are determined, as this is fully given in the Report for 1890. It may, however, be stated that the reductions of the star transits were, from the beginning of the year to the end of

October, effected by means of the equatorial values of the transit wires deduced from all the transits of circumpolar stars observed in 1892, namely ;—A = + 20·060s., B = + 10·508s., D = − 9·463s., E = − 19·013s., with a correction of + 0·418s. to the middle wire when all the wires were observed. For some time it was suspected that the correction + 0·418s. was too small. At the close of October a re-determination of the equatorial values from all the transits of circumpolar stars previously observed in 1893 was made, which revealed the circumstance that a sensible change had taken place between February 14 and 17 in the distances of wires A and B from the middle wire C. The following are the resulting equatorial values before and after the change of distance:

Equatorial values from circumpolar transits Jan. 1 to Feb. 14 :— A + 20·057s., B + 10·523s., D − 9·400s., E − 18·987s.

Equatorial values from circumpolar transits Feb. 17 to Oct. 31 :— A + 20·550s., B + 10·381s., D − 9·330s., E − 19·021s.

It has not been thought necessary to re-reduce the transit observations from February 17 to October 31, as the greatest error in the time can scarcely exceed a tenth of a second. The transits from October 31 to the end of the year were reduced with the second set of values just above given. A reduction of all the circumpolar transits from February 17 to December 31 gives the following values:—A = + 20·553s., B = + 10·385s., D = − 9·328s., E = − 19·020s., with a correction of + 0·518s. to the middle wire. For the future it is proposed to make the reductions of the circumpolar transits keep pace with the observations themselves, for in this way any change in the equatorial values of the wires will be immediately detected.

It will be seen by the following table that the instrumental errors have fluctuated about the same as usual, and that the rate of the chronometer was satisfactory. There was no instrumental adjustment during the year. The number of separate determinations of level, collimation and azimuth were, respectively, 353, 42 and 151, and the three errors fluctuated between the following extremes, respectively, + 3·3″ − 8·6″, + 3·0″ − 0·6″ and − 8·29″ + 3·83″. The mean of all the azimuth determinations for the year is − 2·15″. The total number of transits of stars, of a declination less than 40°, is 899, and these were observed on 153 nights. In the following table the errors enclosed in square brackets have been simply interpolated from preceding and following actual determinations. The apparent right ascensions of both clock and azimuth stars have been interpolated throughout from the *American Ephemeris*, and corrected for daily aberration. In conclusion

it is gratifying to find that the suggestion contained on page 5 of the last Annual Report has met with a favourable reception at the hands of Dr. A. M. W. Downing, the Superintendent of our own *Nautical Almanac.* It is proposed, as soon as possible, to add considerably to the list of southern azimuth stars in this publication.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			″	″	″		H. M.	M. S.	S.	S.
Jan. 1	5	E.	0·9	[0·3]	4·46	ι Hydri, *f* Tauri	3 54	10 42·28	0·086	0·09
„ 2	5	E.	0·9	[0·4]	3·57	δ Hydri, δ Ceti	2 36	10 44·27	0·088	0·10
			—	+	—					
„ 3	5	E.	0·4	[0·5]	4 53	δ Hydri, δ Ceti	3 9	10 47·01	0·112	0·11
			+	+	—					
„ 5	1	E.	1·1	[0·6]	[4·3]		3 39	10 52·84	0·120	0·11
„ 7	7	E.W.	1·1	0·8	4·00	α Ceti, ι Hydri, E.	3 34	10 57·37	0·095	0·09
„ 8	6	W.	1 3	[0·7]	3·31	α Ceti, ι Hydri	2 57	10 59·48	0·090	0·09
„ 9	3	W.	2·7	[0·5]	[3·8]		4 33	11 1·72	0·088	0·08
„ 10	5	W.	3·3	[0·4]	4·27	α Ceti, ι Hydri	3 7	11 3·37	0·073	0·08
„ 11	5	W.	3·0	[0·3]	3·46	α Ceti, ι Hydri	3 21	11 5·54	0·090	0·09
„ 12	3	W.	3·1	[0·1]	3·79	ι Hydri, *f* Tauri	3 32	11 7·82	0·094	0·08
„ 13	8	W.E.	2·5	0·0	3·05	ι Hydri, *f* Tauri, W.	3 16	11 9·63	0·075	0·09
„ 14	1	E.	1·9	[0·2]	[3·0]		3 39	11 11 93	0·096	0·11
„ 16	6	E.	0·4	[0·5]	2·90	ι Hydri, *f* Tauri	3 28	11 17·94	0·126	0·13
			+	+	+					
„ 17	5	E.	0·6	[0·6]	0·17	ε Tauri, δ Mensæ	4 48	11 21·18	0·128	0·11
			+	+	—					
„ 19	7	E.W.	1·0	1·0	5·50 2·91	η Tauri, γ Hydri, E. δ Mensæ, τ Tauri, W.	4 25	11 25·13	0·083	0·08
„ 20	2	W.	1·3	[0 9]	2·14	ε Tauri, δ Mensæ	4 29	11 27·03	0·079	0·08
„ 24	2	W.	0·6	[0·6]	[2·6]		4 22	11 34·63	0·079	0·08
„ 25	6	W.	0·5	[0·5]	2·66	γ Tauri, δ Mensæ	4 9	11 36·57	0 082	0·08
			—	+	—					
„ 26	10	W.E.	0 6	0·4	1·84	δ Doradûs, α Orionis, E.	5 0	11 38·75	0·088	0·08

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level −	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transit's.
1893.			″	″	″		H. M.	M. S.	S.	S.
Jan. 27	5	E.	0·7	[0·6]	2·34	30 Monocerotis, θ Chamæl..	8 19	11 40·63	0·069	0·06
			+	+	—					
„ 28	6	E.	0·8	[0·9]	1·26	ε Tauri, δ Mensæ	4 41	11 41·63	0·049	0·06
„ 29	4	E.	2·0	[1·1]	[1·2]		4 41	11 43·31	0·070	0·07
„ 31	2	E.	0·6	[1·5]	[1·1]		5 23	11 46·19	0·059	0·06
Feb. 2	8	E.W.	1·2	2·0	0·92	ε Tauri, δ Mensæ, E.	4 52	11 49·09	0·061	0·05
„ 3	3	W.	1·5	[1·9]	[1·4]		14 18	11 50·65	0 047	0·05
„ 6	5	W.	2·0	[1·4]	2·98	γ Geminorum, ζ Mensæ	6 53	11 53·96	0·051	0·05
„ 8	7	W.	1·3	[1·1]	[1·6]		5 16	11 56·35	0·052	0·06
					0·51	ε Tauri, δ Mensæ, W.				
„ 9	10	W.E.	1·0	1·0	+		5 12	11 57·72	0·057	0·05
			+	+	1·32	γ Geminorum, ζ Mensæ, E.				
					—					
„ 9	7	E.	0·7	[1·0]	2·28	β Chamæleontis, β Hydri	11 54	11 58·04	0·048	0·05
„ 13	3	E.	1·1	[0·9]	2·42	d Bootis, δ Octantis	14 30	12 3·18	0·052	0·05
„ 14	8	E.	1·3	[0·9]	1·15	δ Doradûs, α Orionis	5 42	12 4·01	0·055	0·06
„ 17	6	E.W.	1·0	0·8	1·45	δ Doradûs, α Orionis, W.	5 36	12 9·14	0·071	0·07
„ 20	4	W.	0·1	[0·8]	[2·9]		6 47	12 13·51	0·060	0·06
„ 21	5	W.	0·4	[0·8]	3·44	μ Geminorum, Canopus	6 12	12 14·88	0·059	0·08
			—	+	—					
„ 21	2	W.	0·5	[0·8]	[3·4]		15 1	12 15·67	0·090	0·09
„ 23	8	W.E.	1·4	0·8	[3·6]		5 34	12 18·49	0·073	0·07
„ 24	8	E.	0·6	[0·9]	3·65	μ Geminorum, Canopus	5 44	12 20·18	0·070	0·07

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			″	″	″		H. M.	M. S.	S.	S.
Feb. 25	6	E.	0·1	[1·0]	1·76	δ Doradûs, α Orionis	6 15	12 22·03	0·075	0·08
„ 25	4	E.	−0·8	+[1·0]	−[2·2]		15 57	12 22·86	0·086	0·08
„ 27	6	E.	+0·3	+[1·3]	−3·75	δ Doradûs, α Orionis	5 48	12 25·26	0·063	0·07
„ 27	5	E.	−0·6	+[1·3]	−[3·2]		15 55	12 26·10	0·083	0·08
„ 28	8	E.W.	0·1	1·4	2·45	δ Doradûs, α Orionis, E.	5 59	12 27·16	0·075	0·08
„ 28	4	W.	+0·2	+[1·4]	−[2·4]		15 53	12 27·94	0·079	0·08
March 3	6	W.E.	0·9	0·6	2·30	δ Doradûs, α Orionis, W.	6 15	12 31·84	0·063	0·06
„ 12	10	E.W.	−0·8	+0·6	−1·91 0·84	σ Octantis, E. γ^2 Piscis Vol., δ Geminor W.	7 4	12 46·09	0·066	0·07
„ 13	7	W.	+0·3	+[0·5]	−0·88 0·39	σ Octantis γ^2 Piscis Vol., δ Geminor	7 1	12 47·90	0·076	0·07
„ 14	6	W.	−0·4	+[0·5]	−2·58	σ Octantis	7 0	12 49·51	0·067	0·07
„ 16	4	W.	+0·2	+[0·3]	−[0·6]		7 3	12 53·56	0·084	0·08
„ 18	10	W.E.	−0·3	+0·2	+1·28	γ^2 Piscis Vol., β Canis Min., W.	7 44	12 57·11	0·073	0·07
„ 19	7	E.	+0·3	+[0·3]	−1·36	σ Octantis	6 42	12 58·53	0·062	0·06
„ 20	6	E.	1·5	[0·5]	2·00	ζ Mensæ, ζ Geminorum	7 1	12 59·95	0·058	0·09

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			"	"	"		H. M.	M. S.	S.	S.
Mar. 21	5	E.	0·5	[0·6]	0·76 1·04	σ Octantis γ^2 Piscis Vol., β Canis Min.	7 28	13 1·80	0·128	0·11
„ 23	5	E.	0·4	[0·9]	1·79	30 Monocerotis, θ Chamæl.	8 44	13 5·24	0·070	0·08
			—	+	+					
„ 24	7	E.W.	0·3	1·0	1·65	γ^2 Piscis Vol., β Canis Min. E	7 51	13 7·28	0·088	0·09
„ 26	4	W.	0·0	[0·9]	[1·1]		17 26	13 11·95	0·081	0·08
			+	+	+					
„ 29	6	W.	0·7	[0·7]	0·17	30 Monocerotis, θ Chamæl.	8 28	13 16·61	0·074	0·07
			—	+	—					
„ 31	8	W.E.	0·2	0·6	2·04	30 Monocerotis, θ Chamæl. E.	8 0	13 19·62	0·063	0·07
April 3	4	E.	1·7	[0·7]	1·84	30 Monocerotis, θ Chamæl.	8 39	13 25·33	0·079	0·11
„ 4	6	E.	2·1	[0·8]	0·96	30 Monocerotis, θ Chamæl.	8 7	13 28·02	0·115	0·13
„ 5	6	E.	1·4	[0·8]	2·00	30 Monocerotis, θ Chamæl.	8 3	13 31·31	0·138	0·10
„ 6	5	E.	1·2	[0·8]	1·47	θ Hydræ, β Argûs	9 1	13 32·95	0·066	0·07
„ 8	3	E.	1·0	[0·9]	[1·5]		12 43	13 37·33	0·085	0·08
„ 10	8	E.W.	0·4	1·0	2·92 0.13	30 Monocerotis, θ Chamæl. E. θ Hydræ, β Argûs W.	8 59	13 41·06	0·084	0·08
			—	+	+					
„ 11	10	W.	0·6	[0·7]	0·83 — 0·74	30 Monocerotis, θ Chamæl. θ Hydræ, β Argûs	8 50	13 42·91	0·078	0·08
			—	+						
„ 11	4	W.	0·6	[0·7]	[0·2]		17 19	13 43·61	0·083	0·08
„ 13	6	W.	0·1	[0·0]	[1·7]		18 10	13 47·47	0·079	0·08
				—	—					
„ 15	10	W.E.	0·0	0·6	3·45	ζ Chamæl., π Leonis W.	10 8	13 50·42	0·074	0·07

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. −	Instrumental Errors. Collimation. −	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			"	"	"		H. M.	M. S.	S.	S.
April 16	6	E.	0·4	[0·3]	1·00	30 Monocerotis, θ Chamæl.	8 25	13 52·08	0·075	0·08
„ 17	5	E.	1·0	[0·1]	2·09 1·27	30 Monocerotis, θ Chamæl. θ Hydræ, β Argûs	8 59	13 53·99	0·078	0·07
„ 18	5	E.	— 1·4	+ [0·2]	+ 0·32 0·07	θ Chamæleontis, σ Hydræ θ Hydræ, β Argûs	9 4	13 55·62	0·068	0·07
„ 20	5	E.	— 1·6	+ [0·7]	— 1·48	l Leonis, δ^2 Chamæleontis	10 39	13 59·46	0·078	0·07
„ 21	7	E.W.	— 0·5	+ 1·0	+ 0·83	30 Monocerotis, θ Chamæl. E.	9 21	14 1·10	0·072	0·07
„ 22	5	W.	+ 0·7	+ [0·9]	— 0·67	θ Hydræ, β Argûs	9 25	14 2·79	0·070	0·06
„ 23	4	W.	0·8	[0·8]	1·87	θ Hydræ, β Argûs	9 5	14 3·96	0·049	0·06
„ 24	10	W.	+ 1·0	+ [0·7]	+ 0·40 — 0·52	θ Hydræ, β Argûs l Leonis, δ^2 Chamæleontis	10 3	14 5·78	0·073	0·08
„ 25	4	W.	0·3	[0·6]	0·13	30 Monocerotis, θ Chamæl.	8 24	14 7·76	0·089	0·08
„ 28	5	W.E.	0·0	0·4	0·65	ζ Chamæleontis, π Leonis W.	10 56	14 12·85	0·068	0·07
May 8	4	E.	— 1·0	+ [0·9]	— 0·28	ρ Octantis, a Serpentis	15 34	14 30·97	0·074	0·06
„ 9	10	E.W.	+ 0·1	+ 1·0	— 0·[illegible]3	β Chamæleontis, β Hydri W.	11 58	14 32·07	0·054	0·07
„ 10	2	W.	— 0·4	+ [0·9]	+ [0·2]		11 44	14 33·96	0·080	0·08

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level −	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			″	″	″		H. M.	M. S.	S.	S.
May 11	5	W.	0·3	[0·7]	0·47	θ Hydræ, β Argûs	9 5	14 35·57	0·075	0·08
„ 13	5	W.	0·1	[0·4]	1·67	θ Hydræ, β Argûs	9 3	14 39·16	0·075	0·07
„ 15	3	W.E.	1·1	0·2	1·57	θ Chamæleontis, β Hydri W.	12 15	14 42·65	0·068	0·04
			—	+	—					
„ 16	5	E.	1·0	[0·3]	4·62 5·28	θ Hydræ, β Argûs o Leonis, ζ Chamæleontis	9 39	14 43·35	0·033	0·05
„ 17	4	E.	2·0	[0·3]	2·94	θ Hydræ, β Argûs	9 38	14 45·08	0·072	0·08
„ 18	6	E.	2·3	[0·4]	3·23	l Leonis, δ² Chamæleontis	11 24	14 47·14	0·080	0·09
„ 19	10	E.	2·0	[0·5]	3·10	β Chamæleontis, β Hydri	12 5	14 49·74	0·105	0·09
„ 20	5	E.	3·0	[0·5]	[1·6]		13 15	14 51·60	0·074	0·07
„ 21	10	E.W.	2·2	0·6	0·09	β Chamæleontis, β Hydri W.	11 22	14 53·26	0·075	0·08
„ 22	4	W.	2·6	[0·4]	[0·7]		12 17	14 55·15	0·076	0·07
„ 24	10	W.	2·0	[0·0]	1·79	l Leonis, η Octantis	11 43	14 58·55	0·072	0·07
			—	—	—					
„ 25	10	W.E.	2·2	0·2	5·04	β Chamæleontis, β Hydri E.	11 8	15 0·01	0·062	0·07
„ 26	2	E.	2·3	[0·1]	[5·0]		14 18	15 1·88	0·069	0·07
			—	+	—					
June 15	5	E.	2·7	[0·9]	5·06	γ Apodis, β Herculis	17 2	15 39·34	0·078	0·08
„ 16	5	E.W.	2·2	1·0	4·16	β Chamæleontis, β Hydri E.	12 32	15 40·83	0·076	0·07
„ 17	2	W.	2·2	[0·9]	[5·4]		12 42	15 42·59	0·073	0·08
„ 18	4	W.	2·7	[0·7]	6·56	γ¹ Virginis, δ Muscæ	13 14	15 44·95	0·096	0·09
„ 19	6	W.	2·3	[0·6]	5·18	κ Octantis, ζ Virginis	13 29	15 47·21	0·093	0·08
„ 20	6	W.	2·9	[0·5]	3·51	ρ Octantis, α Serpentis	15 34	15 49·12	0·073	0·07
„ 22	6	W.E.	2·7	0·2	6·71	ε Serpentis, δ¹ Apodis E.	15 41	15 52·65	0·073	0·07
July 25	5	E W.	1·7	0·8	3·72	κ Virginis, δ Octantis E.	14 48	17 7·71	0·095	0·16

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. −	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			″	″	″		H. M.	M. S.	S.	S.
July 25	4	W.	1·2	[0·8]	4 82	ε Delphini, β Pavonis	20 46	17 8·67	0·161	0·16
„ 28	2	W.	2·6	[0·6]	2·46	δ^1 Apodis, β Herculis	16 42	17 16·30	0·112	0·09
„ 29	4	W.	2·3	[0·5]	3·80	α Tri. Aust., κ Ophiuchi	16 50	17 18·31	0·083	0·08
„ 30	4	W.	3·0	[0 5]	2 95	α Tri. Aust., κ Ophiuchi	17 22	17 20·33	0·082	0·08
Aug. 1	2	W.	2·4	[0 3]	[3·8]		17 16	17 24·38	0 085	0·08
„ 3	8	W.E.	2·7	0 2	2·80 6·42	α Apodis, ε Bootis W. α Tri. Aust., κ Ophiuchi E.	15 55	17 27·57	0·068	0·08
„ 5	5	E.	3·4	[0·1]	5·40	α^1 Herculis, δ Aræ.	17 22	17 32·50	0·100	0·15
„ 5	8	E.	2·8	[0·1]	4·81	γ^1 Octantis, ω Piscium	0 12	17 33·57	0·156	0·14
„ 6	5	E.	1·9	[0·0]	5 30	α Tri. Aust., κ Ophiuchi	17 13	17 35·23	0·098	0·11
„ 7	7	E.W.	2 1	0·0	5·63 7·42	δ Aræ, μ Herculis W. γ Draconis, γ^2 Sagittarii W.	17 36	17 38·25	0·124	0·11
„ 8	5	W.	1·7	[0·1]	[5·3]		17 26	17 40·56	0·097	0·11
„ 9	5	W.	1·7	[0·2]	2·61 5·70	γ Apodis, β Herculis α Tri. Aust., κ Ophiuchi	17 4	17 43·29	0·116	0·10
„ 11	6	W.	0·9	[0·3]	3·45	α^1 Herculis, δ Aræ	17 27	17 47·24	0·082	0·08
„ 12	8	W.E.	1·1	0·4	6 53	ε Serpentis, δ^1 Apodis W.	16 49	17 48·95	0·073	0·07
„ 13	6	E.	1·5	[0·5]	[6 0]		17 24	17 50·35	0·057	0·07
„ 15	7	E.	1·1	[0 6]	4·72 5·47	η Serpentis, ζ Pavonis σ Octantis	18 36	17 54·92	0·093	0·09
„ 24	8	E.W.	0·0	1·0	6·74 5·27	α Tri. Aust., κ Ophiuchi E. γ Draconis, γ^2 Sagittarii W.	17 30	18 15·83	0·097	0·10
Sept. 18	8	W.E.	0 3	1·0	4·33	γ Aquilæ, ε Pavonis E.	19 59	19 24·54	0·114	0·11
„ 19	2	E.	1·4	[1·0]	4·58	σ Octantis	19 17	19 27·43	0·124	0·13

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. −	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			"	"	"		H. M.	M. S.	S.	S.
Sept. 20	4	E.	0·2	[1·0]	4·28	σ Octantis	19 27	19 30·85	0·142	0·13
			+	+	—					
„ 21	5	E.	0·1	[1·0]	4·34	σ Octantis	19 34	19 33·63	0·115	0·12
„ 22	5	E.	0 7	[1·0]	4·20	σ Octantis	18 55	19 36·43	0·120	0·12
„ 23	5	E.	1·9	[1·0]	4·45	σ Octantis	19 10	19 39·32	0·119	0·12
„ 24	7	E.W.	1·7	1·0	2·68	γ Aquilæ, ε Pavonis E.	20 14	19 42·26	0·117	0·13
„ 25	4	W.	2·6	[1·0]	3·14	σ Octantis	19 14	19 45·76	0·152	0·15
„ 29	7	W.E.	1·7	1·0	3·24	ε Delphini, β Pavonis W.	20 52	20 0·59	0·152	0·06
„ 29	5	E.	1·4	[1·0]	[2·9]		5 34	20 1·01	0·018	0·06
„ 30	6	E.	2·5	[0·9]	0·16 4·53	Altair, ε Pavonis ε Delphini, β Pavonis	20 28	20 2·24	0·083	0·09
			—	+	+					
Oct. 3	6	E.W.	0·3	0·6	1·15	β Aquarii, λ^1 Octantis W.	20 34	20 9·93	0·107	0·10
„ 15	7	W.E.	1·6	0·2	1·05 — 8·29	α Aquarii, υ Octantis W. β Octantis, λ Aquarii E.	22 48	20 35·82	0·086	0·14
„ 16	5	E.	0·6	[0·7]	4·93	β Aquarii, λ^1 Octantis	21 37	20 39·06	0·142	0·15
„ 17	8	E.	0·4	[1·2]	5·76 4·91	ε Delphini, β Pavonis ι Piscium, γ^1 Octantis	21 50	20 43·08	0·166	0·15
„ 18	7	E.	1·7	[1·7]	2·86	β Aquarii, λ^1 Octantis	21 15	20 46·39	0·141	0·16
„ 19	10	E.W.	0·5	2·2	1·35 2·23	λ^1 Octantis, α Aquarii E. υ Octantis, γ Aquarii E.	22 51	20 51·07	0·183	0·22
„ 19	4	W.	1·2	[2·2]	[1·8]		1 8	20 51·59	0·228	0·23
			—	+	+					
„ 20	4	W.	0·3	[2·1]	0·85	β Aquarii, λ^1 Octantis	21 40	20 55·59	0·205	0·19

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. −	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			″	″	″		H. M.	M. S.	S.	S.
Oct. 21	2	W.	0·7	[1·9]	[0·5]		22 43	20 59·95	0·174	0·18
			—	+	—					
" 23	1	W.	0·8	[1·6]	[0·2]		22 37	21 8·83	0·185	0·16
" 24	4	W.	0·2	[1·4]	0·59	η Aquarii, β Octantis	22 44	21 12·26	0·142	0·14
			—	+	+					
" 26	3	W.	0·5	[1·2]	0·38	η Aquarii, β Octantis	22 27	21 18·46	0·130	0·14
			+	+	+					
" 27	5	W.	0·1	[1·0]	2·96	η Aquarii, β Octantis	22 53	21 22·06	0·147	0·15
			—	+	+					
" 29	4	W.	1·8	[0·7]	[3·1]		22 55	21 28·86	0·142	0·14
" 31	5	W.E.	2·8	0·4	3·23	β Aquarii, λ^1 Octantis W.	21 48	21 35·04	0·132	0·11
			—	+	—					
Nov. 1	5	E.	2·5	[0·6]	1·58	β Aquarii, λ^1 Octantis	22 13	21 37·51	0·101	0·10
" 2	3	E.	2·6	[0·7]	3·92	α Aquarii, υ Octantis	22 44	21 40·03	0·103	0·10
" 4	5	E.	1·4	[1·1]	2·78	η Aquarii, β Octantis	23 4	21 45·03	0·104	0·10
" 5	4	E.	0·9	[1·3]	2·10	α Aquarii, υ Octantis	22 41	21 47·43	0·102	0·10
" 15	8	E.W.	1·9	3·0	0·41	η Aquarii, β Octantis E.	23 29	22 10·75	0·097	0·09
" 23	8	W.E.	2·7	1·0	0·35	ι Piscium, γ^1 Octantis W.	0 8	22 27·86	0·089	0·07
" 23	5	E.	2·8	[1·0]	2·55	γ Hydri, A^1 Tauri	4 4	22 28·14	0·071	0·07
" 25	6	E.	2·2	[1·1]	0·48	ι Piscium, γ^1 Octantis	23 42	22 32·46	0·074	0·08
Dec. 3	7	E.W.	3·8	1·6	1·27	β Chamæleontis, β Hydri E.	0 36	22 53·13	0·107	0·11
" 4	2	W.	3·4	[1·6]	[1·0]		1 4	22 55·94	0·115	0·11
" 7	2	W.	2·7	[1·7]	[0·1]		1 4	23 4·24	0·115	0·11
			—	+	+					
" 9	2	W.	3·1	[1·7]	[0·5]		1 4	23 9·01	0·099	0·10

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level −	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1893.			″	″	″		H. M.	M. S.	S.	S.
Dec. 16	2	W.	4·5	[1·8]	[2·5]		2 59	23 24·51	0·091	0·11
,, 17	8	W.E.	5·1	1·8	2·79	β Hydri, ε Piscium W.	1 37	23 27·09	0·114	0·11
,, 18	4	E.	2·4	[1·8]	1·69	ε Tauri, δ Mensæ	4 53	23 30·10	0·110	0·11
,, 21	6	E.	5·4	[2·0]	0·96	α Ceti, ι Hydri	3 12	23 38·01	0·113	0·10
					3·83	Achernar, ο Piscium E.				
,, 22	11	E.W.	4·8	2·0	0·76	δ Hydri, δ Ceti E.	2 53	23 40·24	0·094	0·08
					0·04	ζ Arietis, ι Hydri W.				
,, 23	6	W.	5·4	[2·0]	0·55	δ Hydri, δ Ceti	3 12	23 41·98	0·072	0·07
,, 25	5	W.	5·2	[2·0]	0·00	ξ^1 Ceti, δ Hydri	2 30	23 45·84	0·082	0·09
					3·78	μ Hydri, γ Ceti				
,, 31	4	W.E.	8·6	2·0	3·78	δ Hydri, δ Ceti W.	2 29	23 59·58	0·095	

Note.—Transits could not be observed with the clamp east on May 15 and December 31.

Extra-Meridian Work.

This will be treated under the same headings as in former Reports.

OCCULTATIONS OF STARS BY THE MOON.—With the two equatorials twenty-eight disappearances of stars were observed at the moon's dark and five at the bright limb, and seven re-appearances at the dark and five at the bright limb, altogether forty-five phases. Most of the stars have been identified, and nine *Nautical Almanac* stars were observed in both phases. Interesting phenomena were presented at the disappearance of τ^1 Arietis on January 26, the particulars of which are given in Vol. III., page 187, of the *Journal of the British Astronomical Association*. It is very desirable that this star should be examined with a powerful telescope, as it is probably a triple one. Altogether 579 occultation phases have been observed here in the period 1864-93, namely :—527 disappearances and 52 re-appearances.

CONJUNCTION OF SATURN AND γ VIRGINIS.—An excellent series of filar micrometer comparisons of the planet, with the preceding or north component of this well-known double star, was obtained with the 8-inch equatorial on April 3, 4, 5, 6, 8, 10, 11, and it has been found that the tabular corrections for the planet are closely accordant with those obtained at the Royal Observatory, Greenwich, on April 10, 12.

OCCULTATION OF SATURN AND TITAN.—May 25—This phenomenon was observed with the 8-inch equatorial under excellent conditions. Both phases of the occultation of the planet were well observed, but the disappearance only of the satellite at the dark limb. The results have been sent to the *Astronomical Society of the Pacific.*

MINOR PLANETS.—*Hebe (6)* and *Parthenope (11)* were observed with the 8-inch equatorial and filar micrometer, the former on October 27,29, November 1, 2, 4, 5, embracing 75 comparisons and 3 comparison stars, and the latter on September 20, 21, 22, 23, 24, 25, 29, comprising 106 comparisons and 4 comparison stars. The results have been sent to the *Astronomische Nachrichten.*

COMETS.—It has been already notified in the Report for 1892 that Comet VI. (Brooks), 1892, was observed from November 28 to the close of that year. The observations have, however, been carried on with the 8-inch equatorial, with occasional interruptions from moonlight and cloudy weather, till June 19. The complete series of observations from November 28, 1892, to June 19, 1893, comprises 62 nights, 670 comparisons and 89 comparison stars. Dr. Ristenpart's parabola represents very closely the whole series. Comet II. (Rordame-Quenisset), 1893,

was observed with the 4½-inch equatorial and square bar-micrometer on July 29, 30, August 1, 3, 5, 6, 7, 8, 11, 12, 13, the number of comparisons being 67, and that of the comparison stars, 16. The results have been published in the *Astronomische Nachrichten.*

The Binary Star α Centauri.—At the request of Dr. T. J. J. See, of Chicago, a series of measures of this star was obtained with the 8-inch equatorial on ten nights, six east and four west of the meridian. The measures were immediately dispatched to Dr. See, and they have since appeared in the *Monthly Notices* of the Royal Astronomical Society. In consequence of the pressure of other work no other double stars were observed during 1893.

Meteorological Observations.

The usual meteorological observations were made regularly at 9h. a.m. throughout the year, and the rainfall results communicated to the Government Astronomer. 1893 is the thirty-first year in this department of observation.

Publications.

No publication has proceeded directly from the Observatory during the year, but the following is a continuation of the list of papers which have appeared in various scientific journals:

Results of Micrometer Comparisons of Saturn and γ^1 Virginis, in April, 1893.—*R.A.S. Monthly Notices*, Vol. LIII., p. 500.

Star Occultations observed in 1892.—*Astronomische Nachrichten*, Band CXXXIII., No. 3174, p. 95.

Observations of Comet, 1892, VI. (Brooks).—*Astronomische Nachrichten*, Band CXXXIII., No. 3176, p. 125, No. 3180, p. 195, and No. 3189, p. 347. *Journal of the Royal Society of N. S. Wales*, Vol. XXVII., p. 348.

Observations of Phenomena of Jupiter's Satellites in 1892.—*R.A.S. Monthly Notices*, Vol. LIV., p. 32.

On the Probability of Extraordinarily High Spring-Tides about the December Solstice of 1893.—*Journal of the Royal Society of N. S. Wales*, Vol. XXVII., p. 359.

Windsor Measures of α Centauri in 1893.—*R. A. S. Monthly Notices*, Vol. LIV., p. 123.

Observations of Planet (11) Parthenope and Comet, 1893, II.—*Astronomische Nachrichten*, Band CXXXIV., No. 3207, p. 241.

The Library.

The author again tenders his best thanks for the donations to the Library during the past year. A list of these presents will be found at the close of the Report. It will shortly be necessary to extend the shelving for the accommodation of this important department of the Observatory.

Personal Establishment.

All the astronomical and nearly all the meteorological observations have been made by the proprietor. During an occasional absence from home, the latter observations have been made by his son. The greater portion of the astronomical reductions have been made by the former. Mr. Murray L. Allen, of Collector, has been employed in the calculation of star reductions, parallax factors, and sundry other data; but check calculations of these results have been made by different forms by the author himself. Those calculations which are not done in duplicate are usually made according to forms, which are in their nature self-checking. The daily meteorological reductions are made by the author, and the calculation of the monthly sums and means is performed, independently, by two computers. The author has the gratification once more to acknowledge the volunteer services of Mr. R. T. A. Innes, of Sydney, F.R.A.S., who supplied him with his prediction-calculations of the occultations of Saturn and the principal *Nautical Almanac* stars.

Observations Recently Utilized.

The Windsor measures of α Centauri have, since the last Report, been employed by Mr. Alexander W. Roberts, of South Africa, and Dr. T. J. J. See, of Chicago University, in new investigations of the orbit of this well-known binary. See *Astronomische Nachrichten*, Band CXXXIII., p. 105, and *R.A.S. Monthly Notices*, Vol. LIV., p. 102, respectively. The local observations of Finlay's Comet made in 1886 with the 8-inch equatorial and square bar-micrometer, have been availed of by Dr. Schulhof in an investigation of the elliptic elements of this comet for the epoch of its discovery. See *Bulletin Astronomique*, Tome X., Nos. for Avril, Mai, Juin and Juillet, 1893. The residuals of the observations, 42 in number, are remarkably consistent, and all the positions, without exception, are adopted for the definitive correction of the elements. Of the four stations in the southern hemisphere, which contributed observations, Windsor stands second in order, both as regards the number of observations and the weight accorded to the individual results. This is very gratifying, considering the faintness of the comet,

and, therefore,. the difficulty which was frequently experienced in the observations. Early in June last a letter, accompanied with an ephemeris, was received from Dr. Schulhof, requesting that the comet which had just returned to perihelion and been re-discovered by Mr. Finlay, might be followed as long as possible. Circumstances, however, unfortunately prevented the author from complying with the wishes of the astronomer.

Work Proposed for the Year 1894.

It is already well known that the main work of the Observatory consists of the observations of lunar occultations of stars, of southern comets, and of the meteorological instruments. The meteorological observations will be carried through the year with the same regularity as heretofore, but it is proposed to make some relaxation in the astronomical work for the first half of the year. Occultations will be observed, but instead of keeping up a regular series of observations for time, the time will be determined on those nights only when occultations occur by securing a group of transits, both immediately before and after the observation of an occultation. Should a southern comet appear, it is proposed to obtain a number of positions sufficient for a fairly good determination of the orbit. The author trusts by the middle of the year to re-commence regular work.

April 1st, 1894.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1893.

[Note.—The Names of the Donors are printed in Italics.]

Results of Meteorological Observations in N. S. Wales, 1890, pp. XIII, 140, with map.

Results of Rain, River and Evaporation Observations in N. S. Wales, 1891, pp. XL., 151, and 1892, pp. XL., 163, with maps and diagrams.

Diagram of Isothermal Lines for N. S. Wales.

Hailstorms, by H. C. Russell, C.M.G., etc., pp. 4, with chart.

Observations of the Transit of Venus, 1874, Dec. 9, in N. S. Wales, pp. XXVIII, 43, with plates.

Results of Astronomical Observations at Sydney Observatory in 1879-80-81, pp. XVIII., 124, with maps.

The Government Observatory, Sydney.

Record of Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory, etc., from July 1 to Dec. 31, 1892, pp. 31.

The Government Observatory, Melbourne.

Rainfall for South Australia in Monthly Parts, from September, 1892, to September, 1893, both inclusive.

Meteorological Observations at Adelaide Observatory and other places in South Australia, 1890, pp. XIII., XV., 117, with maps, and 1884 and 1885, pp. XXVII., 240 and 238.

The Government Observatory, Adelaide.

Report of Trustees of Free Public Library, Sydney, for 1892.

The Trustees.

The Surveyor. Complete in Monthly Numbers for 1893.

The Institution of Surveyors, N. S. Wales.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, Vol. VIII., pp. 80.

The Queensland Branch of the R. G. Society of Australasia.

Hourly Means at the Four Observatories under the Meteorological Council, 1889, pp. 112, and 1890, pp. 112.

Weekly Weather Reports for 1892.

Weekly Weather Reports from January 7, to November, 1893, both inclusive.

Quarterly Summaries of the Weekly Weather Reports for 1892, and the first three quarters of 1893.

Monthly Summaries for 1892, and January, 1893.

Meteorological Observations at Stations of the Second Order for 1888, pp. 180.
Report of the Meteorological Council to the Royal Society for the year ending March 31, 1892, pp. 111.
Report of the International Meteorological Conference of Munich, Aug. 26–Sept. 2, 1891, pp. 93.

The Meteorological Office, London.

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, 1892, pp. 80.

The Stonyhurst College Observatory.

Report of the Kew Observatory, Richmond, Surrey, for 1892, pp. 33.

The Kew Observatory.

Meteorological Department, Borough of Southport, Report of Observations for 1892, pp. 14.
Weather of 1892 at Southport, by J. Baxendell, F.R.M.S., pp. 15.

Southport Meteorological Observatory.

Report on the Temple Observatory, Rugby, for 1892, pp. 3.

The Temple Observatory.

Meteorological Observations at Rousdon Observatory, Devon, for 1892. pp. 29, by C. E. Peek, M.A.

The Author.

Report of the Wolsingham Observatory, Tow Law, England, for 1892, pp. 2.

Rev. T. Espin, B A.

Results of Observations of Fixed Stars with the Meridian Circle at the Madras Observatory, 1887, 1888 and 1889, pp. 350.
Hourly Meteorological Observations at the Madras Observatory from January, 1856, to February, 1861.

The Government Observatory, Madras.

Monthly Weather Review, Meteorological Service of the Dominion of Canada, from August, 1892, to May, 1893, both inclusive.
Toronto General Meteorological Register for 1892.

The Meteorological Office, Toronto.

The American Ephemeris and Nautical Almanac for 1895, 1st Ed., pp. 532.

Office of the American Ephemeris.

Observations of Double Stars at the U.S.N. Observatory, Washington, Part II., 1880-91, by A. Hall, pp. 203.
Report of the U.S.N. Observatory for the year ending June 30, 1892, pp. 10.

Observations in 1888 at the U.S.N. Observatory, with 2 Appendices and 6 plates

Meteorological Observations and Results at the U.S.N. Observatory, 1888, pp. 60.

Magnetic Observations at the U.S.N. Observatory, 1891, pp. 100, with diagrams.

The U.S.N. Observatory, Washington.

The Lick Astronomical Department of the University of California, pp 22, with plates.

Terrestrial Atmospheric Absorption of the Photographic Rays of Light, by J. M. Schœberle, pp. 89.

The Lick Observatory.

Publications of the Cincinnati Observatory (12) Catalogue of Proper Motions of Stars, by J. G. Porter, A.M., etc., pp. 254.

The Cincinnati Observatory.

The Parallaxes of μ and θ Cassiopeiæ from Rutherford Photo Measures, by H. Jacoby.

Columbia College Observatory, New York.

Transactions of the Astronomical Observatory of Yale University, Vol. I., Parts III. and IV., pp. 153 to 207.

Report of Yale University Observatory for 1892-93, pp. 20.

Yale University Observatory.

Publications of the Washburn Observatory, Vol. VI., Parts III. and IV.

The Washburn Observatory.

Bulletin of the Franklin Institute, Philadelphia, for September, November and December, 1892.

Ship Canals, by M. Haupt, pp. 15.

The Road Movement, by M. L. Haupt, Consult. Engineer, pp. 16.

Report of Proceedings of the 9th Annual Meeting of Official Agricultural Chemists, Washington, August 25-27, 1892, by Dr. Bruno Terne, pp. 20.

A New Photo-Intaglio Process, by L. E. Levy, pp. 4, with plate.

A New Ballistic Galvanometer, by E. G. Willyoung, pp. 17, with diagrams.

Some Principles that must be observed to make a good Closed Circuit Battery, etc., Abstract, pp. 4, 2 copies.

How the Earth is measured, by Prof. J. H. Gore, pp. 19.

Proceedings of the Chemical Section for November 15, 1892, and of the Electrical Section for November 22, 1892.

Philadelphia's Share in the Development of Photography, by J. T. Sachee, pp. 17.

The Deposits of Native Soda, near Laramie, by H. Pemberton, Jun., and G. P. Tucker, pp. 6.

The Franklin Institute, Philadelphia.

Rapport Annuel sur l'Etat de l'Observatoire de Paris pour 1892, pp. 31.

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ERRATA.

In the Report for 1892 :—

Page 12. Sept. 24, *insert* W after ϵ Pavonis
,, 13. Nov. 19, ,, E ,, ω Piscium
,, 28. Line 19 from top, *for* A read G

Ann Arbor Observatory.
Michigan.

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1894.

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association; Corresponding Member of the Societe Ethnographique of Paris, and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

SYDNEY:
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CONTENTS.

APPENDIX.

REPORT

OF THE

WINDSOR OBSERVATORY

For 1894.

NOTWITHSTANDING that there was some relaxation in the work of observation during the year it will be seen from the following Report that a large amount of work was done :—

Buildings and Instruments.

With the exception of a circular chamber for the 8-inch equatorial, the erection of which had been commenced when the last report was issued, there has been no addition to the buildings. This chamber is now completed. It is constructed of brick, has an internal diameter of 18 feet, and is surmounted by a ten-sided pyramidal roof of galvanized iron, with openings 18 inches in width, affording an uninterrupted view from horizon to horizon. The roof turns on ten wheels 13½ inches in diameter, running on a circular plate of iron provided with a rail to keep the wheels in their proper track. This plan has been in use throughout at the Observatory, and is found to answer well. The new structure will add greatly to the comfort of the observer. No addition has been made to the instruments since the acquisition of the large equatorial telescope in 1886, and the list remains therefore as follows :—

Transit Instrument, by Cooke and Sons, of York, of 3 inches aperture and 36 inches focal length.

Two eight-day sidereal Box Chronometers, one by Parkinson and Frodsham, No. 1042; the other by John Poole, No. 2962, beating half-seconds.

Equatorial Refractor, by Grubb, of Dublin, 1882, of 8 inches aperture and 115 inches focal length, driven by clock-work, with filar-micrometer and various eyepieces by the same maker.

Equatorial Refractor, by Cooke and Sons, of York, of $4\frac{1}{2}$ inches aperture and 70 inches focal length, with position and distance filar-micrometer, and various eyepieces by the same makers. This micrometer is also adapted to the 8-inch instrument.

Two Ring-Micrometers and a Square Bar-Micrometer, adaptable to both the equatorials.

Portable Refractor, by Chas. Jones, of Liverpool, of $3\frac{1}{4}$ inches aperture and 48 inches focal length. This instrument was formerly roughly mounted as an equatorial in the old Observatory.

Five-inch Theodolite, $7\frac{1}{2}$-inch Sextant, and other minor appliances.

Position of the Observatory.

The co-ordinates of the Observatory are still adopted as :—Longitude from Greenwich = 10h. 3m. 20·5s. E.; Astronomical Latitude = − 33° 36′ 30·8″.

Meridian Work.

The sidereal chronometer, *John Poole*, No, 2962, was employed during the year in connection with the 3-inch transit instrument, and its rate proved to be satisfactory. For an explanation of the method by which the errors of the transit instrument were determined the reader is referred to the Report for 1890. The equatorial distances in sidereal time of the outer transit wires from the middle wire were those determined from the transits of circumpolar stars from February 17 to December 31, 1893, namely—A = + 20 553s., B = + 10·385s., D = − 9·328s., E = − 19·020s., with a correction of + 0·518s. to the middle wire C for an equatorial star when all the wires were observed. The reductions of the circumpolar-star transits during 1894 for the equatorial distances were made to keep pace with the observations themselves, but no further sensible change was detected in the distances of the outer wires from the middle wire.

The following are the equatorial distances deduced from the circumpolar transits for 1894 :—A = + 20·556s., B = + 10·439s., D = − 9·335s., E = − 19·024s., with a correction of + 0·527s. to the middle wire. These values will be employed for the year 1895. It will be seen from the last Report that the instrumental errors were pretty steady during the year 1893. During the year 1894, however, the level and azimuth errors have not been so steady. This will be seen from the customary table of Instrumental Errors and Chronometer Errors and Rates. Three

adjustments had to be made for level, though none was made for either collimation or azimuth. On reference to previous reports it will be seen that the azimuth error *west* gradually increased till 1890, when the angle of deviation arrived at a maximum. Since that year the angle diminished till about the close of 1893, when the axis of collimation became coincident with the north point of the horizon. The azimuth error gradually increased eastward till November last, when it arrived at a maximum. Since that time the axis of collimation moved rather rapidly westward, becoming again coincident with the north point in the beginning of December. Since the close of the year the azimuth *west* has increased till at the date of this Report it has attained to about 13″. No cause can at present be assigned for these interesting changes of azimuth. The number of separate determinations of level, collimation and azimuth during the year were respectively 203,33 and 81. The total number of transits of stars of a declination less than 40° is 450, and these were observed on 79 nights. The following table exhibits the errors of the transit instrument and the errors and rates of the sidereal chronometer *John Poole*, which was also employed throughout in the extra-meridian observations. The apparent right ascensions of both clock and circumpolar stars have been interpolated from the *American Ephemeris*, and corrected for daily aberration :—

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. −	Collimation. +	Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1894.			″	″	″		H. M.	M. S.	S.	S.
Jan. 14	6	E.W.	12·7	2·0	5·33	γ Hydri, A¹ Tauri, E.	4 33	24 25·94		
Feb. 20	6	W.E.	22·5 1·7	2·6	6·05	γ Geminorum, ζ Mensæ, E.	6 44	25 28·82	0·071	
Mar. 16	9	E.W.	+ 7·1	+ 2·0	3·03 + 9·22 6·97	μ Geminorum, Canopus, E. u Geminorum, ζ Mensæ, E. γ² Piscis Vol., δ Geminor, W.	7 6	25 59·55	0·053	0·06
,, 26	10	W.E.	12·5	0·4	2·20 2·02	γ² Piscis Vol., β Canis Min W β Cancri, θ Chamæl. E.	8 1	26 14·09	0·060	0·07
,, 27	6	E.	12·5	[0·4]	1·46	β Cancri, θ Chamæleontis	8 18	26 15·73	0·068	0·07
April 2	6	E.W.	14·1	0·4	1·71 7·69	30 Monocerotis, θ Chamæl. E. θ Hydræ, β Argûs, W.	9 7	26 26·08	0·071	0·09
,, 3	5	W.	+ 14·8	+ [0·4]	— 0·11 + 0·61	Canopus, γ Geminorum γ² Piscis Vol., β Canis Min.	7 33	26 28·06	0·088	0·09
,, 4	4	W.	+ 15·7	+ [0·5]	— 0·56 + 1·71	Canopus γ Geminorum γ² Piscis Vol , β Canis Min.	7 25	26 30·27	0·093	0·08
,, 5	3	W.	+ 16·2	+ [0·6]	— 0·11	γ Geminor, ζ Mensæ	7 3	26 32·07	0·076	0·08
,, 6	6	W.E.	17·1	0·6	1·46	Canopus, γ Geminor, W.	7 1	26 33·93	0·078	0·06
,, 7	2	E.	18·4	[0 7]	[0·8]		8 35	26 34·87	0·037	0·05
,, 8	2	E.	18·1	[0·8]	[0·2]		8 17	26 36·53	0·070	0·07

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1894.			″	″	″		H. M.	M. S.	S.	S.
April 12	4	E.	19·1	[1·2]	2·42	γ^2 Piscis Vol., δ Geminorum	7 44	26 43·01	0·068	0·06
„ 14	6	E.W.	{18·7 — 2·4}	1·4	1·41	γ^2 Piscis Vol., β Canis Min. E.	7 39	26 45·59	0·054	0·06
				+	+					
„ 16	3	W.	2·5	[1·3]	[0·6]		7 54	26 48·82	0·067	0·05
„ 17	5	W.	2·1	[1·2]	0·18	γ^2 Piscis Vol., β Canis Min.	7 21	26 49·83	0·043	0·05
„ 20	4	W.	2·3	[1·1]	0·69	θ Chamæleontis, σ Hydræ	8 31	26 54·51	0·064	0·04
„ 21	7	W.E.	3·0	1·0	1·59	γ^2 Piscis Vol., β Canis Min. W.	7 44	26 55·39	0·038	0·06
„ 22	5	E.	3·2	[1·2]	[1·8]		7 21	26 57·46	0·088	0·07
„ 23	4	E.	3·3	[1·3]	2·08	γ^2 Piscis Vol., β Canis Min.	7 39	26 58·88	0·058	0·07
„ 24	4	E.	2·7	[1·5]	2·26	γ^2 Piscis Vol., β Canis Min.	7 49	27 0·95	0·086	0·08
„ 25	3	E.	1·3	[1·6]	[1·8]		10 48	27 3·12	0·080	0·08
„ 26	4	E.	1·5	[1·8]	1·41	γ^2 Piscis Vol., β Canis Min.	7 36	27 4·68	0·075	0·08
„ 27	3	E.	1·9	[1·9]	1·27	θ Hydræ, β Argûs	9 27	27 6·72	0·079	0·08
			—	+	—					
„ 30	5	E.W.	{1·9 4·5}	2·4	2·29	κ Octantis, ζ Virginis, W.	13 21	27 13·18	0·085	0·08
May 1	4	W.	2·4	[2·2]	[0·8]		11 17	27 15·01	0·083	0·08
			—	+	+					
„ 2	4	W.	1·9	[2·1]	0·68	υ Leonis, β Chamæleontis	12 20	27 17·17	0·086	0·08
„ 3	4	W.	2·0	[1·9]	0·56	ζ Chamæleontis, π Leonis	10 14	27 18·90	0·079	0·08
„ 4	5	W.	1·0	[1·7]	0·24	β Chamæleontis, β Hydri	12 38	27 20·99	0·079	0·08
„ 5	6	W.	0·9	[1·6]	0·32	30 Monocerotis, θ Chamæl.	8 46	27 22·66	0·083	0·08
			+	+	+					
„ 6	7	W.E.	1·2	1·4	0·29	30 Monocerotis, θ Chamæl. E.	8 15	27 24·39	0·074	0·08
„ 7	4	E.	1·8	[1·5]	2·08	30 Monocerotis, θ Chamæl.	8 45	27 26·46	0·084	0·08

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level +	Collimation +	Azimuth +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1894.			"	"	"		H. M.	M. S.	S.	S.
May 8	4	E.	2·0	[1·6]	1·21	30 Monocerotis, θ Chamæl.	8 31	27 28·20	0·073	0·08
„ 9	2	E.	2·3	[1·7]	[1·6]		12 25	27 30·37	0·078	0·07
„ 10	4	E.	2·0	[1·7]	1·96	30 Monocerotis, θ Chamæl.	9 1	27 31·84	0·071	0·07
„ 11	5	E.	1·8	[1·8]	0·67	30 Monocerotis, θ Chamæl.	8 48	27 33·25	0·059	0·07
„ 12	5	E.	1·1	[1·9]	0·00	δ^2 Chamæleontis, p^3 Leonis	11 21	27 35·22	0·074	0·07
„ 13	6	E.W.	1·3	2·0	1·17	30 Monocerotis, θ Chamæl. E.	9 6	27 36·76	0·071	0·08
„ 14	4	W.	1·3	[2·0]	[2·3]		10 29	27 38·91	0·085	0·09
„ 15	6	W.	1·5	[2·0]	3·42	30 Monocerotis, θ Chamæl.	8 9	27 40·92	0·093	0·04
„ 15	11	W.E.	1·6	2·0	2·02 1·23	δ^2 Chamæleontis, p^3 Leonis, W β Chamæleontis, β Hydri, E.	11 48	27 41·01	0·025	0·03
June 7	5	E.W.	0·0	2·6	5·56	β Chamæleontis, β Hydri, W.	11 58	28 25·72	0·081	0·07
„ 10	3	W.	0·1	[2·4]	[4·0]		12 29	28 30·96	0·072	0·07
			+	+	—					
„ 16	8	W.E.	0·2	2·0	0·26 + 2·25	δ Muscæ, θ Virginis, W. κ Octantis, ζ Virginis, W.	14 0	28 41·45	0·072	0·04
			—	+						
„ 16	6	E.	0 6	[2·0]	2·35	σ Octantis	19 21	28 41·67	0·041	0·04
			+	+	+					
„ 24	7	E.W.	1·5	2·2	3·51 1·74	β Chamæleontis, β Hydri, E. δ Muscæ, ϵ Virginis, W.	13 4	28 51·12	0·051	0·12
„ 24	6	W.	1·5	[2·2]	9·19	ϵ Pavonis, τ Aquilæ	19 55	28 51·95	0·121	0·12
July 7	2	W.	0·3	[2·2]	[6 2]		14 2	29 14·16	0·073	0·09
Aug. 22	4	W.	3·9	[2·0]	4·61	γ^1 Octantis, ω Piscium	0 19	31 8·57	0·139	0·27
„ 22	7	W.E.	2·0	2·0	4·64	ϵ Piscium, κ Tucanæ, W.	1 43	31 8·96	0·275	0·27
„ 26	5	E.	7·0	[2·1]	~~5·19~~	~~κ Ophiuchi~~, δ Aræ	17 36	31 16·07	0·081	0·11
„ 26	4	E.	7·1	[2·1]	8·14	π Piscium, Achernar	2 12	31 17·05	0·114	0·11

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Collimation. +	Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer. H.	M.	Chronometer Fast at Mean of Transits. M.	S.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1894.			"	"	"		H.	M.	M.	S.	S.	S.
Sept. 9	12	E.W.	4·9	2·6	9·32 6·84 7·18	Altair, ϵ Pavonis, E. ϵ Delphini, β Pavonis, E. α Aquarii υ Octantis, W.	21	18	31	50·85	0·102	0·11
„ 14	7	W.E.	5·5	3·0	4·62 8·92	σ Octantis, W. ϵ Pavonis, τ Aquilæ, E.	19	54	32	5·44	0·123	0·12
„ 14	5	E.	4·5	[3·0]	5·99	δ Hydri, ξ^2 Ceti	2	32	32	6·23	0·119	0·12
„ 20	2	E.	6·6	[2·7]	[5·1]		2	37	32	23·60	0·121	0·11
„ 22	2	E.	8·8	[2·6]	[4·8]		19	48	32	28·19	0·111	0·12
„ 23	4	E.	8·9	[2·6]	4·63	σ Octantis	19	41	32	30·99	0·117	0·15
„ 23	8	E.W.	8·9	2·6	6·34 5·18	η Tauri, γ Hydri, E. ϵ Tauri, δ Mensæ, E.	5	10	32	32·50	0·159	0·16
Oct. 5	3	W.	8·9	[1·5]	[10·7]		20	39	33	4·54	0·115	0·09
„ 6	4	W.E.	11·3	1·4	11·13	ϵ Pavonis, τ Aquilæ, W.	20	53	33	6·73	0·090	0·09
„ 8	3	E.	+ 10·4	+ [2·5]	— 1·65	θ Aquilæ, α Pavonis	20	46	33	10·59	0·081	0·10
„ 10	7	E.W.	+ 10·1	+ 3·6	+ 4·78	η Aquarii, β Octantis, E.	23	16	33	16·86	0·124	0·12
„ 22	7	W.E.	9·4	2·6	7·79	υ Octantis, π Aquarii, W.	22	36	33	45·59	0·100	0·10
„ 31	5	E.	8·2	[2·6]	[7·0]		20	39	34	6·84	0·099	0·10
„ 31	10	E.W.	8·3	2·6	7·59 6·42	α Aquarii, υ Octantis, E. η Aquarii, β Octantis, E.	23	26	34	7·15	0·111	0·11
Nov. 4	2	W.	10·1	[1·6]	[3·8]		21	58	34	16·01	0·094	0·08
„ 5	6	W.E.	9·0	1·4	3·04	α Ceti, ι Hydri, E.	3	0	34	18·41	0·083	0·08
„ 8	7	E.W.	7·6	2·6	4·83 7·37	α Aquarii, υ Octantis, E. β Octantis, λ Aquarii, W.	23	17	34	26·67	0·090	0·10
„ 8	8	W.	7·2	[2·6]	6·19	δ Hydri, ξ^2 Ceti	2	35	34	27·01	0·103	0·10

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level. +	Instrumental Errors. Collimation. +	Instrumental Errors. Azimuth. +	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1894.			"	"	"		H. M.	M. S.	S.	S.
Nov. 9	3	W.	9·2	[2·4]	[7·2]		22 55	34 29·05	0·100	0·10
„ 10	6	W.E.	8·9	2·2	8·28	η Aquarii, β Octantis, W.	23 34	34 31·85	0·114	0·10
„ 10	5	E.	7·8	[2·2]	[7·7]		9 22	34 32·85	0·102	0·10
„ 11	7	E.W.	12·4	2·2	6·98	η Aquarii, β Octantis, W.	22 55	34 34·36	0·111	0·12
„ 14	2	W.	11·9	[2·3]	[5·6]		23 30	34 44·46	0·139	0·14
„ 21	2	W.	14·0	[2·4]	[2·5]		2 23	35 8·98	0·143	0·13
„ 23	7	W.E.	14·6	2·4	1·55	ι Piscium, γ^1 Octantis, E.	23 47	35 14·86	0·130	0·13
„ 27	2	E.	18·0	[2·8]	[0·5]		2 12	35 27·15	0·125	0·13
			+	+	—					
Dec. 2	6	E.W.	20·3 — 3·8	3·2	0·78	β Chamæleontis, β Hydri, E.	0 58	35 41·93	0·125	0·15
			—	+	+					
„ 4	9	W.E.	4·7	3·0	0·34	β Hydri, ε Piscium, W.	1 48	35 49·75	0·160	0·15
			—	+	—					
„ 5	4	E.W.	3·4	3·6	1·66	β Chamæleontis, β Hydri, E.	0 41	35 53·09	0·146	0·14
„ 6	5	W.	1·3	[3·6]	[1·8]		2 7	35 56·33	0·127	0·12
„ 10	3	W.	0·7	[3·6]	[2·5]		1 20	36 7·23	0·114	0·10
			+	+	—					
„ 14	10	W.E.	4·3	3·6	2·83 4·17 2·75	δ Doradûs, α Orionis, W. ζ Mensæ, ζ Geminorum, E. γ^2 Piscis Vol., δ Geminorum, E	6 42	36 16·37	0·090	0·09
„ 20	2	E.	5·5	[3·4]	[5·7]		1 52	36 29·55	0·095	0·11
„ 21	6	E.W.	5·9	3·4	6·06	ε Piscium, κ Tucanæ, E.	2 0	36 32·23	0·111	0·11

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level +	Collimation. +	Azimuth. −	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1894.			″	″	″		H. M	M. S.	S.	S.
Dec. 22	3	W.	6·9	[3·4]	[5·9]		4 8	36 34·91	0·103	0·10
„ 23	4	W.	9·0	[3·4]	5·73	δ Hydri, ξ^2 Ceti	2 47	36 37·30	0·106	0·11
„ 24	2	W.	10·4	[3·5]	[6·1]		11 35	36 40·76	0·105	0·10
1895.										
Jan. 2	8	W.E.	{ 18·0 3·2 }	3·6	9·23	ξ^1 Ceti, δ Hydri, W.	2 47	37 0·43	0·095	

NOTES.

The level error was found to be −22·5″ on February 20, and the eastern pivot was lowered before the observations.

The level error was found to be +18·7″ on April 14, and the eastern pivot was raised before the observations.

In reversing the instrument on April 30, the mounting sustained a jerk which appears to have slightly changed the level error for clamp W., but not to have had any sensible effect on the azimuth.

In the afternoon of December 2, previously to the observations, the level error was found to be +20·3″, and the eastern pivot was therefore raised, when the level error was found to be −2·4″.

An observation could not be obtained on December 5 with the clamp W.

The eastern pivot was raised during the observations of January 2, 1895.

Extra-Meridian Work.

Occultations of Stars by the Moon.—With the two equatorials twenty-six disappearances were observed at the moon's dark and six at the bright limb, and eight reappearances at the dark and the same number at the bright limb, altogether forty-eight phases. All the stars, with the exception of five, have been identified, and ten observations of *Nautical Almanac* stars were made in both phases. Among the occultations completely observed is that of Antares on October 31, the disappearance of which was observed in full sunlight and the reappearance in strong twilight. The attempted observation of the daylight occultations of Spica and Antares on November 24 and December 24 respectively was unsuccessful, the former in consequence of a smoky atmosphere, and the latter in consequence of cloud. The total number of occultation phases observed here since the establishment of the Observatory in 1864 is 627, namely: 559 disappearances and 68 reappearances. The results for 1894 have been sent to the *Astronomische Nachrichten.*

Daylight Occultation of Venus by the Moon 1894, May 1.—The disappearance was observed under excellent conditions with the 8-inch equatorial. The reappearance at the dark limb was lost in consequence of cloud. The result has been sent to the journal just named.

Transit of Mercury, 1894, November 10.—Both contacts at egress were very satisfactorily observed with the 4½-inch equatorial, and the results sent to the same journal.

Conjunction of Uranus and α Libræ, 1894, October 5.—In consequence of cloudy weather observations could be secured on one evening only, but this, fortunately, was within twelve hours of the conjunction. Twenty excellent comparisons were made in the evening twilight with the Grubb filar-micrometer on the 8-inch equatorial, which give tabular corrections for the planet closely accordant with those obtained at Greenwich at the conjunction of April preceding.

Comets.—Mr. Walter F. Gale, of Paddington, F.R.A.S., reported to the Observatory by telegraph in the forenoon of April 3, civil time, that he had discovered a comet on the 1st in the constellation *Horologium.* It was found on the evening of the 3rd with the 4½-inch equatorial, and observed with that instrument on April 3 and 4. Subsequently the comet, which ranks as II., 1894, was followed with the 8-inch instrument. A telegram announcing the name of the discoverer, the date of

the discovery, and the approximate position for the 3rd, was dispatched to the Melbourne Observatory in the afternoon of the 4th for transmission in the usual way to Kiel. The comet was observed here on April 3, 4, 5, 6, 8, 12, 14, 16, 17, 20, 21, 22, 23, 24, 25, 26, 27, May 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, the number of comparisons being 299, and the number of comparison stars 48. Approximate orbits were computed by the author from the observations of April 3, 12, 21, and of April 3, 21, May 11, and the latter has been found to agree very closely with that derived by Kohlschütter, of Kiel, from the Windsor observation of April 6, a Cape observation of April 13, and European observations of April 28 and May 9. It will be seen that the weather was unusually favourable for the observation of this interesting body. The complete observations have been published in the *Astronomische Nachrichten.*

A letter from Dr. Schulhof, of the Paris Observatory, enclosing an ephemeris of the periodical comet Tempel, 1873 II., for the present return was received in April. Knowing that Mr. Gale was engaged in comet seeking, I forwarded to him an extract from the ephemeris, and in the forenoon of May 12, civil time, I received from him a notification that he had found the comet on the morning of the 10th. In the afternoon of the same day, however, a Kiel cable message was received stating that the comet had been detected by Finlay at the Cape of Good Hope on the 8th. Observations were obtained here with the 8-inch equatorial on the mornings of the 13th and 14th, civil time. Those on the former date were pretty consistent, and the result has since appeared in the *Astronomische Nachrichten.* A search for comet Edward Swift was made on several occasions, but in consequence of the imperfect ephemeris at first received, or the extreme faintness of the object, it could not be found. A short ephemeris, based on the cabled European elements, was kindly calculated and supplied to me by Mr. C. J. Merfield, of Sydney; but notwithstanding a careful search in and near the positions indicated nothing could be seen of the comet.

With the help of Dr. Backlund's ephemeris, in No. 3263 of the *Astronomische Nachrichten*, Encke's comet was readily detected with the 4½-inch equatorial on December 20. The comet, however, being in north declination, and on the confines of the evening twilight, was not observed with the micrometer. The observation of this interesting comet is part of the programme of morning work for the present month when it is in south declination, and not seen at northern observatories.

Double Stars.—Towards the close of the year a selection of the most interesting double stars was observed with the 8-inch equatorial

under excellent conditions. The following is a list of the stars thus measured :—β and ζ Phœnicis, κ Toucani, *h* 3447, *p* Eridani, *h* 3592, Lacaille 2145, α Centauri, γ Coronæ Australis, Lacaille 8550, *h* 5295$\frac{2}{3}$. The measures have been sent to the Royal Astronomical Society.

Variable Stars.—*R* Carinæ was the only variable under observation during 1894, and the comparisons are few and scattered in consequence of the observer's close application to other work. It is, however, satisfactory to know that Mr. A. W. Roberts, of South Africa, is also engaged on this star, so that it is hoped that a continuous record of its interesting variations will be secured.

Meteorological Observations.

These have been made regularly at 9h. a.m. throughout the year. In accordance with custom a return of the daily rainfall has been sent to the Government Astronomer for incorporation with the results obtained at the numerous stations under his direction. Meteorological observations have now been obtained here extending over a period of thirty-two years. The abstracts for 1891-92-93-94 will shortly be published and distributed.

Publications.

The following is a continuation of the list of papers which have appeared from the Observatory in various scientific journals :—

Orbit Elements of Comet Gale (*b* 1894).—*Royal Ast. Society's Monthly Notices*, Vol. LIV., p. 556.

Filar-Micrometer Comparisons of Minor Planet (6) Hebe.—*Astronomische Nachrichten*, Band CXXXV., p. 13.

Observations of Comet 1894 (Gale, April 1).—*Ast. Nach.*, Band CXXXV., p. 261.

Star Occultations observed in 1893.—*Ast. Nach.*, Band CXXXV., p. 333.

The Discovery of Comet 1894 II. (Gale, April 1).—*Ast. Nach.*, Band CXXXVI., p. 95.

Orbit Elements and Further Observations of Comet 1894 II., and Observation of Comet Tempel$_2$ 1894 III. (1873 II.)—*Ast. Nach.*, Band CXXXVI., p. 241.

Observations and Orbit Elements of Comet Gale, 1894.—*Journal of the Royal Society of N. S. Wales.* Vol. XXVIII., p. 129.

A Typographical Correction to Paper on τ^1 Arietis.—*Journal of the British Ast. Association*, Vol. III., p. 384.

Early Observations of Gale's Comet, 1894.—*Journal of the B. A. Association*, Vol. IV., p. 307.

Mr. Tebbutt and the Transit of Venus in 1874.—*Observatory*, Vol. XVII., p. 179.

Orbit Elements of Comet Gale, 1894.—*Observatory*, Vol. XVII., p. 281.

Observation of the Occultation of Saturn and Titan, 1893. May 25—*Publications of the Astronomical Society of the Pacific*, Vol. VI., No. 34, p. 23.

Correction for Astronomische Nachrichten, No. 3235.—*Ast. Nach.*, Band CXXXVI., p. 377.

Result of Micrometer Comparisons of Uranus and α Libræ, 1894. Oct. 5—*R. A. S. Monthly Notices*, Vol. LV., p. 83.

Observation of a Daylight Occultation of Antares, 1894. Oct. 31—*R. A. S. Monthly Notices*, Vol. LV., p. 83.

Observation of the Transit of Mercury, 1894. November 10—*Ast. Nach.*, Band CXXXVII., p. 93.

In the Appendix to this Report will be found a complete index to all the Astronomical Observations of importance which have proceeded from the Observatory from its establishment to the close of 1894

The Library.

This important department of the Observatory continues to be enriched by purchases, and also by presents from kindred institutions. A list of the presents received during the year is given at the close of the Report. The author offers, at the same time, his best thanks to the various donors.

Personal Establishment.

This is precisely the same as that for 189~~4~~3. All the astronomical and about ninety per cent. of the meteorological observations have been made by the proprietor, and by far the greater portion of the astronomical reductions has been made by him. It is extremely difficult to get the occasional assistance of a trustworthy computer. The daily meteorological observations have been made about once a fortnight by

the author's son, who has also computed once the monthly means and sums of the daily results. These means and sums have also been independently computed by Mr. Bruce Walker. An invaluable service has been rendered to the Observatory by Messrs. R. T. A. Innes and Joseph Brooks, Fs.R.A.S., who have kindly furnished it with prediction calculations of the occultation of Venus, and of the principal occultations of stars by the moon.

Observations Recently Utilized.

The local observations of Comet 1891 I. (Barnard-Denning) published in *Ast. Nach.*, Band CXXVIII., pp. 203 and 221, find a place in the Definitive Determination of the Orbit of this Comet by Dr. E. Lamp in No. IX. of the Kiel Observatory Publications. After perihelion passage the comet was seen in the southern hemisphere only, the places of observation being the Royal Observatory, Cape of Good Hope, the Argentine National Observatory, and Windsor. Notwithstanding the excessive faintness of this object, and the extreme difficulty, therefore, in observing it, all the Windsor positions, nine in number, were adopted in the determination of the final elements.

Work Proposed for the Year 1895.

The observation of lunar occultations of stars, of southern comets, and of the meteorological instruments will be continued as heretofore. At the request of Professor R. Luther, of Düsseldorf the minor planets, *Parthenope* and *Hebe* were placed on the working list for January and March respectively; but in consequence of one of the most extraordinary periods of cloudy weather ever experienced here the former planet quite escaped observation. At the date of this Report, however, success has attended the observation of the latter. Ephemerides of minor planets in south declination, whose magnitudes are not less than 9·5, will be at any time acceptable.

March 1, 1895.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1894.

[NOTE.—The names of the Donors are printed in Italics.]

Pictorial Rain Maps, by H. C. Russell, B.A., &c., pp. 4, with map.
On Meteorite No. 2, from Gilgoin Station, by same, pp. 2.
Moving Anticyclones in the Southern Hemisphere, by same, pp. 8, with maps.
Section A of Aust. Association for Adv. of Science. President's Address on the Progress of Astronomical Photography, pp. 27.
The Government Observatory, Sydney.

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory for 1893, also for the period January 1 to March 31, 1894.
The Government Observatory, Melbourne.

Rainfall in South Australia for October, November and December, 1893.
Meteorological Observations at Adelaide Observatory in 1886-87.
The Government Observatory, Adelaide.

The Surveyor of January 5, Feb. 9, March 7, April 7, May 7, June 7, July 9, Aug. 6, Sept. 3, Oct. 9, and Nov. 7, 1894.
The Institution of Surveyors, N. S. Wales.

Report of the Free Public Library, Sydney, for 1893, pp. 8.
The Trustees.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, 1893-94, pp. 104.
The Queensland Branch of the Society.

Greenwich Five-Year Catalogue of 258 Fundamental Stars for 1890, pp. 14 and XIX.
Cape Heliometer Observations for Stellar Parallax, 1881-83, pp. XVII., 167.
The Astronomer Royal for England.

Report of H. M. Astronomer at the Cape of Good Hope, 1879, May 26, to 1889, July 21, pp. 19.
The Admiralty.

Greenwich Mean Times of Superior and Inferior Conjunctions of Jupiter's Satellite *Callisto*, from January 1894 to February 1895, pp. 2.
The Nautical Almanac Office, London.

Weekly Weather Reports, Nov. 25, 1893, to Oct. 20, 1894, both included, with Title page and Preface for 1893.
Summary of Observations at Stations included in the Daily and Weekly Weather Reports, Feb. 1893 to August 1894, both included, but Summaries for October 1893 and June 1894 not received
Summary of Weekly Weather Report, 1893, and Quarterly Summaries of same.

Quarterly Summaries of Weekly Weather Reports, 1894, Jan.-March, April-June, July-Sept.
Weekly Weather Report, Table I., Vol. X., Appendix II., 3rd Series.
Meteorological Observations at Stations of the Second Order for 1889.
Report of the Meteorological Council to the Royal Society for Year ended March, 1893, pp. 115.

The Meteorological Office, London.

Report of the Incorporated Kew Committee for 1893, pp. 35.

The Kew Observatory.

Results of Meteorological, Magnetical and Solar Observations at Stonyhurst College Observatory for 1893.

The Stonyhurst College Observatory.

Report of the Walsingham Observatory for 1893, pp. 2.
The Distribution of Stars of Type III., of Stellar Spectra in Space, by Rev. T. E. Espin, M.A., pp. 7.

The Walsingham Observatory

Report of Results of Observations, 1893, with two Appendices, pp. 30.

The Meteorological Department, Borough of Southport.

Micrometer Observations of Nebulæ at Armagh Observatory, by J. L. Dreyer, Ph.D.

The Armagh Observatory.

Madras Meridian Circle Observations, Vol. VII, for 1880-81-82, pp. XXVIII. and 296.

The Madras Observatory.

Report of the Royal Observatory, Cape of Good Hope, for 1889-92, pp. 9, and for 1893, pp. 17.

The Royal Observatory, Cape of Good Hope.

Monthly Weather Review, June, 1893, to March, 1894, both included.
Toronto General Meteorological Register for 1893.
Report of the Meteorological Service of the Dominion of Canada for 1889, pp. XLVIII., 294.

The Meteorological Office, Toronto.

Report of the U.S. Naval Observatory for the Year ending June 30, 1893, pp. 13.

The U.S. N. Observatory, Washington.

American Ephemeris and Nautical Almanac for 1896, 1st Ed., pp. 534, and for 1897, 1st Ed., pp. 534.

The Office of the American Ephemeris.

Methods of testing Fats and Oils, by Dr. E. Maillian, pp. 22.
A Plea for the Study of Elementary Forestry in the Lower Schools, by E. J. Houston, Ph. D., pp. 21.
Anthracite Coal near Perkismen Creek, by O. C. S., Carter, pp. 5.

The Franklin Institute, Philadelphia.

On the Capture of Comets by Planets, especially by Jupiter, by H. A. Newton, pp. 19.

The National Academy of Sciences.

Publications of the Leander McCormick Observatory, Vol. I., Pt. 6, Southern Nebulæ, pp. 175 to 241.

The Leander McCormick Observatory.

Publications of the Lick Observatory of the University of California, Vol. II., 1894. Double Star Observations of S.W. Burnham, from Aug., 1888, to June, 1892, pp. 255.

The Lick Observatory.

Determination of the Latitude, Longitude, &c., of the Laws Observatory of the University of Missouri, by M. Updegraff.

The Laws Observatory.

Report of Yale University Observatory for the year 1893-94, pp. 20.

The Yale University Observatory.

Publications of the Washburn Observatory of the University of Wisconsin, Vol. VIII., Merid. Circle Obs., 1887-1892, pp. 327.

The Washburn Observatory.

Rapport Annuel de l'Observatoire de Paris pour 1893, pp. 31.

The Paris Observatory.

Publicationen der Sternwarte in Kiel, IX., No. 1, Definitive Bahn-bestimmung des Cometen, 1891 I.. von Prof. Dr. E. Lamp. No. 2, Über die Bahn des Cometen, 1873 V., von Prof. Dr. H. Kreutz. No. 3, Bahn-bestimmung des Planeten (226), Weringia, von Prof. Dr. H. Kreutz, pp. 55.

The Royal Observatory, Kiel.

Ast. Mittheilungen von der Königl. Sternwarte zu Göttingen, Dritter Theil, L. Ambron, Triangulation der Plejadengruppe, mit 2 Tafeln and 1 Photolithographie, pp. 58.

The Royal Observatory, Göttingen.

Sternwarte Hamburg, Bericht des Direktors, Prof. Dr. G. Rümker.

The Hamburg Observatory.

Magnetische und Meteorologische Beobachtungen an der k.k. Sternwarte zu Prag, 1893, pp. XVI. and 41.

The Observatory, Prague.

Meteorologische Beobachtungen angestellt in Dorpat, 1892, von Dr. A. v. Oettingen, pp. 81.

The Meteorological Observatory, Dorpat.

Publication der Charkower Universitats Sternwarte, Heft No. 2, pp. 69 and 23.

The Observatory, Charkow.

Work in Russian Text, containing Observations made with the Transit Instrument in the Prime Vertical at the Astronomical Observatory of the Imperial University of Kasan, pp. LIII. and 210.

The Observatory, Kasan.

Anuario del Observatorio Astronomico Nacional de Tacubaya, XIV., 1893.

Boletin del Observatorio Astronomico Nacional de Tacubaya, Obs. Merid., Tomo I., Nos. 15, 17, 18.

The National Observatory, Tacubaya.

Anuario del Observatorio de la Plata para el ano 1894, pp. 514.
The Observatory, La Plata.

Memorias y Revista de la Sociedad Cientifica "Antonio Alzate," Tomo VII. (1893-4), Nos. 3, 4, 7, 8, 9, 10.
Sociedad Cientifica, "Altonio Alzate."

Annuario publicado pelo Observatorio do Rio de Janeiro, 1893, pp. 336.
The Observatory, Rio de Janeiro.

The Orbit of the Double Star *h* 5014, by R. P. Sellors, B.A., &c., pp. 2.
Observations of Double Stars at Sydney Observatory, by same.
Recent Measures of Double Stars at Sydney, by same.
The Author.

Tables to facilitate the application of Gauss's Method of Computing Secular Variations, by R. T. A. Innes, F.R.A.S.
The Author.

On Stokes' Theorem, by G. Fleuri, pp. 5, with diagrams.
From Number to Quaternion, by same, pp. 29.
The Author.

On a New Form of Telemeter, by G. H. Knibbs, pp. 6.
The Author.

Photographs of Gale's Comet, by E. E. Barnard.
W. F. Gale, F.R.A.S.

Tide Tables for the Port of Brisbane, Moreton Bay, for 1893, by E. A. Cullen, pp. 16.
The Land of Viti, by J. P. Thomson, F.R.S.G.S., pp. 21.
J. P. Thomson, F.R.S.G.S., &c.

Meteorological Work in Australia, a Review by Sir C. Todd, K.C.M.G., &c., pp. 25, with charts.
The Author.

Two Almanacs for 1640, and one for 1667, in one volume.
Rev. S. J. Johnson, M.A.

Observed Conjunctions of Satellite IV. with Jupiter, pp. 2, by Rev. A. Freeman, M.A.
Method of finding the Latitude of Saturn's Belts, pp 4, by same.
The Author.

The Distance of the Nebulæ, by Miss A. M. Clerke, pp. 7, 2 copies.
Stellar Numbers and Distances—the Sun's Motion in Space—and a Southern Observatory, by same, pp. 26.
The Author.

Tellustria: A Method of determining astronomically the Variations in Temperature and Pressure of the Atmosphere, by ~~G. B.~~ Jenkins, F.R.A.S., pp 22, with diagrams. B. S.
The Author.

Meteorological Observations at Rousdon Observatory, Vol. X., for 1893, by C. E. Peek, M.A., pp. 30.
The Author.

Prospectus and Instructions for using Tate's Improved Calculating Machine, pp. 16.
The Publishers.

Ephemeris of the Satellites of Mars, 1894, and Ephemeris for Physical Observation of Jupiter, 1894-5, by A. Marth.

The Author.

Physical Observations of Mars at the Allegheny Observatory in 1892, by J. E. Keeler, D.Sc., pp. 8, with plates.

On the Spectra of the Orion Nebula and the Orion Stars, by J. E. Keeler, pp. 18.

The Author.

On the Orbit of α Centauri, by T. J. J. See, A.M., Ph.D., pp. 19.

The Author.

Solar Electrical Energy not transmitted by Radiation, by M. A. Veeder, M.D., pp. 10.

The Hills of Wayne: Their Story of Tidal Waves, &c., by same, sheet.

The Author.

On the Magnitude of the Solar System, by William Harkness, pp. 22.

The Author.

Thèses (2) présentées a la Faculté des Sciences de Paris, &c., par M. L. Fabry, pp. 214.

The Author.

Beobachtungen von Cometen und kleinen Planeten zu Hamburg von Ende April, 1892, bis Ende December, 1893, von Dr. R. Schorr, pp. 16.

The Author.

Untersuchungen über die warscheinlichste Bahn des Cometen 1825 I., und über seine Identitat mit dem Cometen 1790 III., von Paul Martin, pp. 82.

The Author.

Die Schmidt 'sche Sonnentheorie, &c., von Otto Knopf, pp. 44.

The Author.

Il Pianeta Marte, par Giov. Schiaparelli, pp. 25, with plates.

The Author.

Agrandissements de Photographies Lunaires, Planches I., II., III., par W. Prinz.

The Author.

Le Systeme Solaire se mouvant, par A. Tischner, pp. 19.

The Author.

ERRATA.

In the Report for 1888:—

Page 24. Line 21 from top, *for* p. 18 *read* p. 20.
,, 24 ,, 24 ,, ,, ,, p. 17 ,, p. 19.

APPENDIX.

Index to the Windsor Astronomical Observations, 1857 to 1894.

THE Titles of the various Publications in which the Observations appear are in Italics, and are abbreviated thus :—

H. denotes *Sydney Morning Herald* }
E. „ *Empire* } N. S. Wales Daily Newspapers.
E.N. „ *Evening News* }
M.N. „ *Monthly Notices of the Royal Astronomical Society.*
Mems. R.A.S. denotes *Memoirs of the Royal Astronomical Society.*
A.N. denotes *Astronomische Nachrichten.*
B.A.A. „ *Journal of the British Astronomical Association.*
A.S.P. „ *Publications of the Astronomical Society of the Pacific.*
Ph.S. „ *Transactions of the Philosophical Society of N. S. Wales.*
R.S. „ *Journal of the Royal Society of N. S. Wales.*
O. „ *Observatory.*
A.R. „ *Astronomical Register.*

Observations of Solar Eclipses.

1857, March 26—*H.*, 1857, April 1. 1857, September 18—*H.*, 1857, October 2. 1861, January 11—*H.*, 1861, January 15. 1868, August 18—*E.*, 1868, August 22; *M.N.*, XXIX., 2; *A.N.*, LXXII., 335. 1870, June 28—*M.N.*, XXXI., 83; *A.N.*, LXXVI., 283. 1871, December 12—*H.*, 1871, December 29; *M.N.*, XXXII., 243; *A.N.*, LXXIX., 197. 1876, September 17—*H.*, 1876, September 20; *M.N.*, XXXVII., 11; *A.N.*, LXXXVIII., 365. 1878, February 2—*H.*, 1878, February 6. 1882, November 10—*M.N.*, XLIII., 280.

Observations of Lunar Eclipses.

1866, September 24—*H.*, 1866, September 28; *M.N.*, XXVII., 84; *A.N.*, LXVIII., 203. 1869, July 23—*M.N.*, XXX., 26; *A.N.*, LXXIV., 381. 1870, January 17—*H.*, 1870, January 21; *M.N.*, XXX., 159; *A.N.*, LXXV., 379. 1873, May 12—*M.N.*, XXXIV., 72. 1877, February 27—*H.*, 1877, March 5. 1879, December 28—*H.*, 1879, December 31. 1880, June 22—*A.R.*, XIX., 20. 1880, December 16—*A.R.*, XIX., 89.

Observations of Lunar Occultations of Planets.

Mars, 1875, August 12—*M.N.*, XXXVI., 43. Jupiter and Satellites, 1886, April 16—*A.N.*, CXIV., 411. Venus, 1888, March 9 *M.N.*, XLVIII., 340. Saturn and Titan, 1888, June 13, and 1893, May 25—*M.N.*, XLVIII., 396; and *A.S.P.*, VI., 23, respectively.

Observations of Lunar Occultations of Stars.

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REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1895,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association; Corresponding Member of the Alliance Scientifique of Paris; and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

Sydney:
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REPORT

OF THE

WINDSOR OBSERVATORY

For 1895.

It will be seen from the following report, which is given under the usual heads, that a considerable amount of good work was done during the year :—

Buildings and Instruments.

These remain the same as at the close of the year 1894.

Position of the Observatory.

This is adopted as in the previous report, namely:—Longitude from Greenwich = 10h. 3m. 20.5s. E.; astronomical latitude = $-33° 36' 30.8''$.

Meridian Work.

The rate of sidereal chronometer *John Poole*, No. 2962, which was employed as the timekeeper during the year, proved to be satisfactory. The mean daily gaining rate for the year was 3.05 seconds. A full explanation of the methods adopted for the determination of the errors of the transit instrument is given in the report for 1890. The equatorial distances in sidereal time of the outer wires of the instrument from the middle wire were adopted as A = +20.556s., B = +10.439s., D = −9.335s., E = −19.024s., with a correction of +0.527s. to the middle wire for the upper culmination with the clamp east. These values were derived from a reduction of the transits of all the circumpolar stars observed in 1894. In accordance with the plan adopted in 1894, the transits of circumpolar stars in 1895 were similarly reduced

as they were made, but no sensible change was detected in the equatorial distances of the wires. The distances resulting from the observations of 1895 are:—A=+20.527s., B=+10.508s., D=−9.327s., E=−19.092s., with a correction of +0.523s. to the middle wire. These new values will serve for the year 1896. It will be seen from the report for 1894 that the level and azimuth errors were not so steady as they had been for some years. This unsteadiness continued through 1895. The eastern pivot fell relatively till towards the close of February. From that time it gradually rose till about March 23, but subsequently it fell continuously till the end of the year, and it was found necessary to make repeated adjustments. The north end of the axis of collimation moved persistently westward till the close of August, but did not change much during the last four months of the year. During the year there were 454, 52, and 159 separate determinations of the level collimation and azimuth errors respectively. The total number of transits of stars of a declination less than 40° was 957, and these were observed on 184 nights. It will thus be seen that the meridian work has been heavier than usual. The usual table follows, exhibiting the errors of the transit instrument, and the errors and rates of the chronometer *John Poole,* which was also employed in the extra-meridian observations. The apparent right ascensions of both clock and circumpolar stars have been interpolated from the *American Ephemeris*, the co-ordinate for *ζ Ceti* in December having been increased by 1.00s. Daily aberration was applied to all the right ascensions. In the case of extra-meridian observations, the observed sidereal times have been converted into the corresponding mean times by check operations, namely, once by employing the Greenwich sidereal time at mean noon for the date diminished by 1m. 39.12s., and once by employing the Greenwich mean time of the preceding transit of the First Point of *Aries* increased by 1m. 38.84s.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			″	″	″		H. M.	M. S.	S.	S.
Jan. 2	8	W.E.	+ 18.0 + 3.2	+ 3.6	— 9.23	ξ^1 Ceti, δ Hydri, W.	2 47	37 0.43	0.095	
„ 5	5	E.	+ 3.2	[+ 3.3]	— 8.36	θ Hydræ, β Argûs	9 28	37 6.88	0.082	0.09
„ 6	4	E.	+ 2.2	[+ 3.2]	[— 8.4]		3 31	37 8.48	0.089	0.08
„ 10	9	E.W.	+ 5.1	+ 2.8	— 9.48 — 7.88	δ Hydri, δ Ceti, E. γ Hydri, A¹ Tauri, W.	3 21	0 11.60		
„ 11	8	W.	+ 5.2	[+ 2.8]	[— 9.1]		4 5	0 14.61	0.122	0.11
„ 12	6	W.	+ 6.8	[+ 2.8]	— 9.54	ι Hydri, f Tauri	3 9	0 16.81	0.095	0.10
„ 19	1	W.	+ 13.6	[+ 2.9]	[— 13.1]		4 30	0 31.33	0.086	0.08
„ 23	7	W.E.	+ 5.8	+ 3.0	— 15.13	η Tauri, γ Hydri, W.	3 57	0 38.33	0.073	0.06
„ 24	1	E.	+ 7.0	[+ 3.0]	[— 15.1]		2 57	0 39.62	0.056	0.06
„ 29	5	E.W.	+ 9.3	+ 2.8	— 14.78	γ Hydri, A¹ Tauri, E.	4 32	0 47.75	0.067	0.07
Feb. 4	6	W.E.	+ 8.1	+ 3.0	— 13.96	γ Tauri, δ Mensæ, W.	4 38	0 58.51	0.075	0.07
„ 5	5	E.	+ 8.7	[+ 2.9]	— 13.98 — 15.32	η Tauri, γ Hydri γ Tauri. δ Mensæ	4 7	1 0.09	0.067	0.07
„ 8	8	E.W.	+ 8.9	+ 2.6	— 16.55 — 16.65	η Tauri, γ Hydri, E. γ Tauri, δ Mensæ, E.	4 36	1 4.67	0.063	0.06
„ 9	4	W.	+ 10.2	[+ 2.6]	[— 15.8]		5 39	1 6.19	0.061	0.06
„ 11	4	W.	+ 10.4	[+ 2.4]	[— 14.1]		4 35	1 8.79	0.055	0.06
„ 12	8	W.E.	+ 10.3	+ 2.4	— 14.10 — 12.58	ν Geminorum, ζ Mensæ, E. γ^2 Piscis Vol., δ Gemin. E.	6 24	1 10.30	0.058	0.06
„ 13	7	E.	+ 10.8	[+ 2.4]	[— 13.4]		4 52	1 11.78	0.066	0.06
„ 15	6	E.	+ 10.8	[+ 2.5]	— 13.64	ζ Mensæ, ζ Geminorum	5 20	1 14.94	0.065	0.07
„ 16	4	E.	+ 10.8	[+ 2.5]	[— 13.6]		5 7	1 16.58	0.069	0.07
„ 17	5	E.	+ 10.8	[+ 2.6]	[— 13.5]		5 38	1 18.46	0.077	0.08
„ 18	9	E.W.	+ 11.0	+ 2.6	— 13.41	δ Doradûs, α Orionis, W.	5 17	1 20.32	0.079	0.07

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			″	″	″		H. M.	M. S.	S.	S.
Feb. 19	2	W.	+ 11.2	[+ 2.5]	[— 13.6]		5 30	1 21.99	0.069	0.07
„ 20	3	W.	+ 11.1	[+ 2.3]	[— 13.9]		5 10	1 23.78	0.076	0.08
„ 23	3	W.	+ 10.7	[+ 1.9]	[— 14.5]		6 38	1 29.61	0.079	0.06
„ 24	7	W.E.	+ 10.5	+ 1.8	— 14.71	δ Doradûs, α Orionis, E.	5 24	1 30.90	0.057	0.06
„ 25	3	E.	+ 10.3	[+ 2.0]	[— 13.9]		5 10	1 32.61	0.072	0.07
„ 26	5	E.	+ 11.0	[+ 2.2]	— 13.17	δ Orionis, δ Doradûs	5 32	1 34.32	0.070	0.07
„ 27	5	E.	+ 10.5	[+ 2.4]	— 13.18	δ Doradûs, α Orionis	5 33	1 36.04	0.072	0.07
„ 28	4	E.	+ 9.8	[+ 2.6]	[— 11.7]		5 16	1 37.54	0.063	0.06
Mar. 2	7	E.W.	+ 8.8	+ 3.0	— 8.68	γ^2 Piscis V., β Canis Min. W	6 46	1 40.27	0.055	0.06
„ 3	5	W.	+ 8.5	[+ 3.1]	— 12.70	ε Geminorum, ζ Mensæ	6 39	1 41.67	0.059	0.06
„ 4	5	W.	+ 8.1	[+ 3.2]	— 10.83	ζ Mensæ, ζ Geminorum	6 17	1 43.08	0.060	0.05
„ 5	1	W.	+ 7.6	[+ 3.4]	[— 10.2]		5 21	1 44.04	0.041	0.05
„ 6	3	W.	+ 7.6	[+ 3.5]	— 9.55	ζ Mensæ, ζ Geminorum	6 52	1 45.54	0.059	0.06
„ 7	4	W.E.	+ 6.4	+ 3.6	— 8.86	γ^2 Piscis V., β Canis Min. W	6 40	1 46.83	0.054	0.06
„ 8	6	E.	+ 5.4	[+ 3.7]	— 10.65	δ Doradûs, α Orionis	5 36	1 48.24	0.061	0.06
„ 11	3	E.	+ 4.1	[+ 4.0]	[— 11.0]		6 11	1 52.92	0.064	0.07
„ 12	3	E.	+ 2.8	[+ 4.1]	[— 11.2]		5 50	1 54.47	0.066	0.07
„ 13	6	E.W.	+ 1.7	+ 4.2	— 11.28	β Cancri, θ Chamæleontis, E	8 14	1 56.21	0.066	0.07
„ 14	4	W.	+ 1.4	[+ 3.9]	— 7.77	θ Chamæleontis, σ Hydræ	8 33	1 57.88	0.069	0.06
„ 16	2	W.	+ 0.4	[+ 3.3]	[— 8.8]		8 18	2 0.22	0.049	0.06
„ 17	5	W.	+ 0.1	[+ 3.0]	— 9.27	θ Chamæleontis, σ Hydræ	8 8	2 1.60	0.058	0.14
„ 17	5	W.	— 0.2	[+ 3.0]	— 12.03	κ Octantis, ζ Virginis	13 12	2 2.39	0.156	0.15
„ 19	8	W.E.	— 2.4	+ 2.4	— 11.86	ζ Mensæ, ζ Geminorum, W	7 23	2 8.42	0.143	0.18
„ 22	1	E.	— 2.7	[+ 2.4]	[— 12.9]		8 5	2 17.31	0.122	0.11
„ 23	4	E.	— 3.5	[+ 2.4]	[— 13.2]		10 11	2 20.07	0.106	0.09
„ 24	6	E.	— 3.0	[+ 2.4]	— 18.55	30 Monocerotis, θ Chamæl	7 52	2 21.84	0.082	0.10

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			"	"	"		H. M.	M. S.	S.	S.
Mar. 25	7	E.W.	− 1.9	+ 2.4	− 14.97	ζ Mensæ ζ Geminorum, E.	7 31	2 24.42	0.109	0.12
„ 26	5	W.	− 0.1	[+ 2.5]	− 13.94	γ^2 Piscis Vol., φ Geminor.	7 51	2 27.50	0.127	0.12
„ 28	5	W.	+ 0.4	[+ 2.8]	− 12.04	30 Monocer., θ Chamæl.	8 31	2 32.99	0.113	0.11
„ 31	7	W.E.	+ 3.0	+ 3.2	− 15.96	30 Monocer., θ Chamæl. E.	7 55	2 40.60	0.107	0.10
April 4	5	E.	+ 7.6	[+ 3.1]	− 14.30	30 Monocer., θ Chamæl.	7 11	2 48.89	0.087	0.10
„ 5	5	E.	+ 7.6	[+ 3.0]	− 16.05	30 Monocer., θ Chamæl.	7 22	2 51.30	0.100	0.10
„ 6	9	E.W.	+ 9.0	+ 3.0	− 16.30	30 Monocer., θ Chamæl. W.	7 33	2 53.79	0.108	0.10
„ 7	5	W.	+ 10.1	[+ 2.8]	− 17.53	θ Hydræ, β Argûs	8 51	2 56.29	0.099	0.11
„ 7	5	W.	+ 11.5	[+ 2.8]	− 16.01	δ^1 Apodis, δ Ophiuchi	16 21	2 57.18	0.119	0.10
„ 8	3	W.	+ 11.0	[+ 2.6]	[− 18.3]		8 10	2 58.01	0.053	0.06
„ 10	2	W.	+ 15.9	[+ 2.2]	[− 19.8]		9 22	3 2.20	0.085	0.10
„ 11	6	W.E.	{ + 16.0 − 4.6 }	+ 2.0	− 20 54	o Leonis, ζ Chamæl. E.	9 4	3 4.67	0.104	0.11
„ 14	4	E.	− 4.9	[+ 2.2]	[− 18.7]		8 7	3 12.84	0.115	0.11
„ 14	3	E.	− 3.7	[+ 2.2]	{ − 18.30 − 18.76 }	η Bootis, θ Apodis d Bootis, δ Octantis	14 4	3 13.50	0.111	0.11
„ 19	6	E.	+ 0.2	[+ 2.5]	− 17.15	η Serpentis, ζ Pavonis	18 3	3 24.75	0.091	0.02
„ 20	2	E.W.	+ 2.0	+ 2.6	[− 17.5]		9 47	3 24.88	0.009	0.06
„ 21	6	W.	+ 2.9	[+ 2.5]	− 17.88	30 Monocer., θ Chamæl.	7 53	3 27.93	0.138	0.14
„ 23	4	W.	+ 4.9	[+ 2.3]	[− 19.1]		7 34	3 34.31	0.134	0.14
„ 25	4	W.	+ 8.9	[+ 2.0]	[− 20.2]		11 0	3 41.41	0.138	0.13
„ 26	2	W.	+ 9.4	[+ 1.9]	[− 20.8]		8 48	3 44.18	0.127	0.12
„ 27	10	W.E.	+ 12.5	+ 1.8	− 21.42	30 Monocer., θ Chamæl. W	8 39	3 47.00	0.118	0.12
„ 30	7	E.	{ + 21.2 − 4.9 }	[+ 2.5]	− 25.68	β Chamæl., β Hydri	10 48	3 55.86	0.119	0.12

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			"	"	"		H. M.	M S.	S.	S.
May 6	8	E.W.	+ 4.3	+ 4.0	– 29.38 – 28.25	ρ Leonis, δ^2 Chamæl., E. η Octantis, δ Leonis, W.	10 36	4 14.42	0.129	0.11
„ 7	5	W.	+ 5.0	[+ 3.6]	– 30.55	o Leonis, ζ Chamæl.	9 41	4 17.08	0.106	0.11
„ 9	7	W.	+ 6.0	[+ 3.0]	– 29.55	η Octantis, δ Leonis	10 56	4 23.22	0.125	0.11
„ 10	10	W.E.	+ 7.3	+ 2.6	– 28.08 – 29.97	o Leonis, ζ Chamæl., W. *l* Leonis, η Octantis, E.	10 10	4 25.59	0.102	0.08
„ 10	4	E.	+ 8.0	[+ 2.6]	– 31.49 – 30.36	δ Muscæ, θ Virginis Spica, κ Octantis	13 32	4 25.86	0.080	0.08
„ 11	6	E.	+ 8.6	[+ 2.6]	– 29.27	ζ Chamæl., π Leonis	9 43	4 28.14	0.113	0.11
„ 13	5	E.	+ 10.8	[+ 2.5]	– 29.43	o Leonis, ζ Chamæl.	9 42	4 32.63	0.094	0.09
„ 15	2	E.	+ 14.4	[+ 2.5]	[– 28.6]		13 17	4 37.92	0.083	0.08
„ 16	4	E.	+ 13.6	[+ 2.4]	– 28.23	β Chamæl., β Hydri	11 17	4 39.70	0.081	0.08
„ 18	6	E.W.	+ 14.9	+ 2.4	– 30.99	*l* Leonis, η Octantis, E.	11 10	4 43.08	0.071	0.10
„ 19	4	W.	+ 16.9 – 16.4	[+ 2.4]	– 27.39	β Chamæl., β Hydri	12 24	4 45.91	0.112	0.12
„ 20	3	W.	– 15.5	[+ 2.5]	[– 30.9]		10 41	4 48.76	0.128	0.12
„ 21	5	W.	– 12.9	[+ 2.6]	– 34.45	η Octantis, δ Leonis	11 26	4 51.63	0.116	0.11
„ 25	7	W.E.	– 9.7	+ 2.8	– 29.85	*l* Leonis, η Octantis, W.	11 32	4 59.71	0.084	0.09
„ 28	4	E.	– 6.2	[+ 2.6]	– 28.22	η Virginis, α^1 Crucis	12 16	5 6.68	0.096	0.11
„ 29	6	E.	– 5.8	[+ 2.5]	– 30.34	ρ Leonis, δ^2 Chamæl.	10 21	5 9.22	0.115	0.11
„ 30	6	E.	– 3.3	[+ 2.5]	– 32.04	η Octantis, δ Leonis	11 13	5 11.77	0.103	0.11
„ 31	6	E.W.	– 3.0	+ 2.4	– 28.70	β Chamæl., β Hydri, W.	11 16	5 14.39	0.109	0.11
June 2	6	W.	+ 2.1	[+ 1.8]	– 29.03	β Chamæl., β Hydri	11 3	5 19.39	0.105	0.13
„ 3	5	W.	+ 4.0	[+ 1.5]	– 29.41	β Chamæleontis, β Hydri	12 57	5 23.24	0.149	0.15
„ 4	4	W.	+ 5.7	[+ 1.2]	[– 29.1]		11 24	5 26.70	0.154	0.15

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer. H.	M.	Chronometer Fast at Mean of Transits. M.	S.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			"	"	"		H.	M.	M.	S.	S.	S.
June 8	8	W.E.	+ 11.5 + 27.5 — 0.8	0.0	— 27.67 — 34.50	β Chamæleontis β Hydri W δ Octantis, ρ Bootis, E.	13	21	5	38.73	0.123	0.12
" 10	5	E.	+ 0.7	[0.0]	— 37.51	β Chamæleontis, β Hydri	11	43	5	44.04	0.115	0.14
" 11	8	E.	+ 1.7	[— 0.1]	[— 37.8]		11	21	5	47.46	0.145	0.15
" 12	3	E.	+ 3.8	[— 0.1]	[— 38.1]		13	2	5	51.25	0.148	0.14
" 13	1	E.	+ 4.7	[— 0.1]	[— 38.3]		13	35	5	54.59	0.136	0.13
" 20	6	E.W.	+ 17.4 + 10.1	— 0.2	— 42.05 — 38.53	δ Muscæ, θ Virginis, W. κ Octantis, ζ Virginis, W.	13	0	6	13.51	0.113	0.11
" 25	8	W.	+ 17.2 — 13.9	[— 0.1]	— 45.31	δ Muscæ, θ Virginis	13	7	6	26.58	0.109	0.11
" 27	1	W.	— 6.6	[0.0]	[— 42.8]		12	31	6	31.88	0.111	0.12
" 28	8	W.E.	— 6.2	0.0	— 41.50	κ Octantis, ζ Virginis, W.	13	14	6	35.47	0.147	0.15
" 29	5	E.	— 4.6	[— 0.2]	— 39.30	β Chamæleontis, β Hydri	13	6	6	38.93	0.145	0.14
" 30	7	E.	— 2.9	[— 0.4]	— 40.53	β Chamæleontis, β Hydri	13	5	6	42.31	0.141	0.16
July 1	5	E.	— 2.0	[— 0.5]	— 41.33	β Chamæleontis, β Hydri	12	16	6	46.22	0.169	0.17
" 2	10	E.W.	— 1.4	— 0.7	— 40.92	β Chamæleontis, β Hydri, E	13	16	6	50.71	0.180	0.19
" 3	7	W.	+ 0.8	[— 0.6]	— 36.93	ρ Octantis, α Serpentis	15	30	6	55.83	0.195	0.17
" 4	4	W.	+ 5.8	[— 0.6]	[— 39.4]		12	27	6	58.88	0.146	0.15
" 5	6	W.	+ 4.1	[— 0.5]	— 41.86	κ Octantis, ζ Virginis	12	56	7	2.44	0.146	0.16
" 5	4	W.	+ 4.3	[— 0.5]	[— 41.9]		20	56	7	3.78	0.168	0.17
" 7	6	W.E.	+ 5.8	— 0.4	— 38.80	β Chamæleontis β Hydri W	13	10	7	10.43	0.165	0.19
" 8	7	E.	+ 7.4	[0.0]	— 40.44	β Chamæleontis, β Hydri	13	45	7	15.37	0.201	0.20
" 9	6	E.	+ 14.4 — 14.8	[+ 0.8]	— 40.89 — 42.60	β Chamæleontis, β Hydri α Apodis, $α^2$ Libræ	13	48	7	19.95	0.190	0.19
" 10	8	E.	— 13.5	[+ 0.7]	— 41.28	β Chamæleontis, β Hydri	12	31	7	24.26	0.190	0.17

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
1895. July 11	5	E.	— 12.4	[+ 1.0]	— 41.53	κ Octantis, ζ Virginis	13 31	7 28.07	0.152	0.16
„ 11	10	E.W.	— 7.5	+ 1.0	— 36.08	Altair, ε Pavonis, W.	18 32	7 28.88	0.161	0.15
„ 12	5	W.	— 5.3	[+ 0.9]	— 40.94	κ Octantis, ζ Virginis	13 31	7 30.87	0.105	0.12
„ 13	3	W.	— 4.3	[+ 0.8]	[— 40.6]		12 30	7 34.17	0.144	0.13
„ 14	4	W.	— 2.3	[+ 0.8]	— 40.20	κ Octantis, ζ Virginis	12 52	7 37.12	0.121	0.14
„ 15	4	W.	— 0.6	[+ 0.7]	— 42.30	κ Octantis, ζ Virginis	13 52	7 41.17	0.162	0.17
„ 16	4	W.	+ 0.6	[+ 0.6]	— 41.40	κ Octantis, ζ Virginis	13 52	7 45.29	0.172	0.17
„ 19	7	W.E.	+ 3.1	+ 0.4	{ — 41.02 — 41.70 }	κ Virginis, δ Octantis, W. β Libræ, ρ Octantis, E.	14 45	7 55.83	0.145	0.15
„ 23	2	E.	+ 5.7	[+ 0.8]	[— 42.7]		12 51	8 10.70	0.158	0.15
„ 25	5	E.	+ 9.1	[+ 1.0]	— 43.33	*d* Bootis, δ Octantis	13 57	8 18.24	0.154	0.16
„ 26	4	E.	+ 10.4	[+ 1.2]	— 42.11	*d* Bootis, δ Octantis	14 1	8 22.13	0.162	0.16
„ 29	4	E.	{ + 15.1 — 8.0 }	[+ 1.5]	— 41.08	α Apodis, ε Bootis	15 12	8 32.43	0.141	0.16
„ 30	7	E.W.	— 6.6	+ 1.6	— 41.86	ε Serpentis, δ^1 Apodis, E.	16 14	8 36.55	0.165	0.16
Aug. 4	3	W.	+ 1.0	[+ 1.5]	[— 41.8]		17 24	8 55.41	0.156	0.16
„ 8	5	W.	+ 5.6	[+ 1.4]	— 41.71	η Serpentis, ζ Pavonis	18 19	9 11.13	0.162	0.15
„ 9	6	W.E.	+ 4.8	+ 1.4	— 41.90	η Serpentis, ζ Pavonis, E.	18 19	9 14.58	0.144	0.15
„ 10	3	E.	+ 8.3	[+ 1.5]	— 43.56	ε Serpentis, δ^1 Apodis	16 2	9 17.75	0.146	0.14
„ 11	6	E.	+ 8.6	[+ 1.6]	— 43.40	ρ Octantis, α Serpentis	15 12	9 21.03	0.142	0.13
„ 12	4	E.	+ 11.1	[+ 1.7]	— 42.81	ρ Octantis, α Serpentis	15 41	9 23.97	0.120	0.12
„ 18	7	E.W.	{ + 17.1 — 11.4 }	+ 2.2	— 43.56	ε Serpentis, δ^1 Apodis, E.	16 18	9 40.86	0.117	0.11
„ 21	3	W.	— 5.5	[+ 2.4]	— 43.88	ε Serpentis, δ^1 Apodis	16 3	9 48.25	0.103	0.08
„ 22	4	W.	— 2.8	[+ 2.5]	— 44.32	ε Serpentis, δ^1 Apodis	15 59	9 50.11	0.078	0.08

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			"	"	"		H.	M.	M.	S.	S.	S.
Aug. 24	10	W.E.	+ 1.2	+ 2.6	— 47.80 — 42.15	γ Apodis, β Herculis, W. σ Octantis, E.	17	5	9	54.68	0.093	0.14
" 25	4	E.	+ 3.7	[+ 2.7]	— 44.58 — 45.56	δ[1] Apodis, σ Cor. Borealis γ Apodis, β Herculis	16	17	9	58.61	0.169	0.17
" 26	2	E.	+ 6.7	[+ 2.8]	[— 44.9]		16	34	10	2.83	0.174	0.18
" 27	3	E.	+ 8.1	[+ 2.9]	— 44.69	σ Octantis	17	8	10	7.21	0.178	0.18
" 28	8	E.W.	+ 11.5	+ 3.0	— 46.38	ε Pavonis, θ Aquilæ, W.	19	25	10	11.96	0.181	0.20
" 29	6	W.	+ 14.0	[+ 2.9]	— 45.62	σ Octantis	17	36	10	16.95	0.225	0.23
" 31	6	W.	+ 19.8 — 11.2	[+ 2.6]	— 49.68	σ Octantis	18	7	10	28.43	0.237	0.23
Sept. 2	4	W.	— 1.4	[+ 2.3]	— 47.92	σ Octantis	17	20	10	38.67	0.217	0.22
" 3	4	W.	— 4.3	[+ 2.2]	[— 47.6]		17	30	10	44.01	0.221	0.22
" 4	8	W.E.	— 0.7	+ 2.0	— 47.21	σ Octantis, E.	17	47	10	49.43	0.223	0.24
" 4	3	E.	— 0.7	[+ 2.0]	— 47.26	ζ Arietis, ι Hydri	3	2	10	51.72	0.248	0.24
" 5	2	E.	+ 2.2	[+ 2.1]	[— 47.7]		17	18	10	55.10	0.237	0.24
" 8	5	E.	+ 10.3	[+ 2.3]	— 49.79 — 47.90	γ Draconis, γ[2] Sagittarii σ Octantis	18	9	11	10.74	0.215	0.24
" 9	3	E.	+ 11.8	[+ 2.4]	— 45.50	Altair, ε Pavonis	20	0	11	17.02	0.243	0.25
" 10	3	E.	+ 10.9	[+ 2.4]	— 49.77	σ Octantis	19	24	11	23.05	0.258	0.25
" 18	7	E.W.	— 9.6	+ 3.0	— 49.87	ε Delphini, β Pavonis, E.	20	50	12	7.09	0.228	0.22
" 20	8	W.	— 4.7	[+ 2.7]	[— 49.9]		18	4	12	17.14	0.222	0.22
" 22	5	W.	— 6.8	[+ 2.4]	[— 50.4]		20	44	12	28.31	0.220	0.25
" 23	3	W.	— 3.1	[+ 2.3]	— 50.67	ε Delphini, β Pavonis	20	45	12	34.72	0.267	0.26
" 27	3	W.	+ 7.5	[+ 1.7]	— 47.23	α Aquarii, υ Octantis	22	17	12	57.10	0.229	0.17
" 28	3	W.	+ 9.0	[+ 1.6]	[— 48.1]		19	42	13	0.47	0.157	0.15
" 29	6	W.	+ 11.3	[+ 1.5]	— 48.94	ε Delphini, β Pavonis	20	26	13	4.21	0.151	0.15

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H.	M.	M.	S.	S.	S.
1895.												
Sept. 30	1	W.	+ 10.5	[+ 1.4]	[— 48.0]		22	14	13	8.28	0.158	0.16
Oct. 5	5	W.E.	+ 11.8	+ 0.6	— 43.42	Altair, ε Pavonis, W.	20	27	13	25.20	0.143	0.14
„ 7	3	E.	+ 13.4	[+ 1.2]	— 44.31	β Aquarii, λ[1] Octantis	21	35	13	32.25	0.143	0.15
„ 10	6	E.	+ 13.6	[+ 2.1]	— 46.85	ε Delphini, β Pavonis	20	21	13	42.78	0.149	0.17
„ 10	4	E.	+ 13.3	[+ 2.1]	[— 48.2]		6	34	13	44.52	0.170	0.16
„ 11	7	E.W.	+ 14.8	+ 2.4	— 49.52	ε Delphini, β Pavonis, W.	20	33	13	46.59	0.148	0.16
„ 11	4	W.	+ 13.7	[+ 2.4]	[— 49.4]		4	11	13	47.91	0.178	0.17
„ 12	3	W.	— 18.0	[+ 2.4]	[— 48.9]		20	16	13	50.46	0.159	0.16
„ 17	6	W.E.	— 15.6	+ 2.6	— 45.48	β Aquarii, λ[1] Octantis, W.	21	51	14	10.93	0.168	0.17
„ 19	4	E.	— 15.5	[+ 2.4]	— 46.34	β Pavonis, ε Cygni	21	14	14	18.75	0.165	0.16
„ 24	6	E.W.	{ — 16.4 / — 0.8 }	+ 2.0	— 45.43	1 Pegasi, λ[1] Octantis, E.	22	9	14	38.19	0.161	0.15
„ 25	4	W.	+ 4.0	[+ 2.0]	— 45.29	λ[1] Octantis, α Aquarii	22	16	14	41.90	0.154	0.16
„ 26	5	W.	+ 5.7	[+ 2.0]	— 45.79	ξ Aquarii, λ[1] Octantis	22	10	14	45.87	0.166	0.17
„ 29	7	W.E.	+ 4.5	+ 2.0	— 47.20	β Aquarii, λ[1] Octantis, W.	22	2	14	58.99	0.183	0.17
„ 29	4	E.	+ 4.8	[+ 2.0]	— 50.81	ι Hydri, f Tauri	3	57	14	59.96	0.164	0.16
Nov. 4	4	E.	+ 18.3	[+ 1.3]	— 47.70	γ[1] Octantis, 33 Piscium	0	24	15	23.48	0.167	0.12
„ 4	6	E.	+ 19.3	[+ 1.3]	— 47.89	ε Geminorum, ζ Mensæ	6	49	15	24.24	0.118	0.12
„ 6	6	E.W.	+ 15.6	+ 1.0	— 48.79	α Aquarii, υ Octantis, E.	22	42	15	29.84	0.140	0.14
„ 8	5	W.	+ 18.4	[+ 1.8]	— 45.66	γ Geminorum, ζ Mensæ	6	25	15	37.25	0.133	0.13
„ 10	6	W.	+ 17.9	[+ 2.6]	— 47.53	ε Geminorum, ζ Mensæ	7	48	15	44.01	0.137	0.15
„ 12	7	W.E.	+ 15.8	+ 3.4	— 48.58	η Aquarii, β Octantis, W.	23	0	15	50.01	0.153	0.16
„ 15	2	E.	+ 15.7	[+ 3.1]	[— 47.5]		22	47	16	1.71	0.163	
„ 19	6	E.	+ 16.7	[+ 2.8]	— 46.01	β Hydri, δ Piscium	0	22	0	16.50		
„ 21	7	E.W.	+ 14.4	+ 2.6	— 45.56	ι Piscium, γ[1] Octantis, W.	23	12	0	21.80	0.113	0.18
„ 22	8	W.	+ 18.0	[+ 2.5]	[— 46.1]		23	5	0	25.17	0.141	0.14

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1895.			″	″	″		H. M.	M. S.	S.	S.
Nov. 24	2	W.	{ + 19.5 / — 10.0 }	[+ 2.3]	— 47.03	γ Pegasi, β Hydri	0 12	0 31.34	0.126	0.13
„ 28	5	W.	— 3.2	[+ 1.8]	— 47.03	γ Pegasi, β Hydri	0 13	0 44.81	0.140	0.13
„ 30	8	W.E.	— 3.5	+ 1.6	— 46.23	ι Piscium, γ¹ Octantis, W.	23 50	0 50.99	0.129	0.11
Dec. 2	3	E.	— 0.3	[+ 1.6]	— 47.07	γ¹ Octantis, ω Piscium	0 4	0 55.21	0.088	0.09
„ 3	4	E.	+ 2.0	[+ 1.7]	— 47.09	β Chamæleontis, β Hydri	0 2	0 57.20	0.083	0.08
„ 9	7	E.W.	+ 6.2	+ 1.8	— 48.31	ξ¹ Ceti, δ Hydri, E.	2 24	1 10.78	0.092	0.09
„ 12	3	W.	+ 8.8	[+ 2.0]	— 47.26	β Hydri, δ Piscium	0 48	1 17.40	0.095	0.11
„ 18	4	W.	{ + 28.4 / — 9.5 }	[+ 2.5]	— 51.83	κ Tucanæ, η Piscium	1 40	1 36.20	0.130	0.18
„ 19	5	W.E.	— 2.9	+ 2.6	— 52.48	ε Piscium, κ Tucanæ, W.	1 13	1 40.53	0.184	0.18
„ 21	3	E.	+ 4.8	[+ 2.3]	[— 52.3]		1 46	1 48.93	0.173	0.18
„ 24	5	E.	+ 10.6	[+ 1.7]	— 51.95	γ Pegasi, β Hydri	23 41	2 1.36	0.178	0.14
„ 26	7	E.W.	+ 15.5	+ 1.4	— 54.42	δ Hydri, ξ² Ceti, W.	1 34	2 7.43	0.122	0.11
„ 28	5	W.	{ + 21.8 / — 8.6 }	[+ 2.1]	— 55.07	ξ¹ Ceti, δ Hydri	1 55	2 12.61	0.107	0.12
„ 30	4	W.E.	— 7.2	+ 2.8	— 52.62	δ Mensæ, τ Tauri, W.	5 0	2 19.69	0.139	0.14
„ 31	4	E.W.	— 5.9	+ 2.4	— 51.94	δ Hydri, δ Ceti, W.	2 11	2 22.52	0.133	
„ 31	3	W.	+ 2.4	[+ 2.4]	+ 18.21	ι Hydri, *f* Tauri	3 23	2 22.43		

NOTES.

The eastern pivot was raised during the observations of January 2nd, April 11th, 30th, May 19th, June 25th, July 9th, 29th, August 18th, 31st, November 24th, December 18th, 28th.

The mounting of the transit instrument sustained a blow just before the conclusion of the transits with clamp W on June 8th, which changed the level error to the extent of 16·0″. The eastern pivot was subsequently raised.

The level error was changed 7.3″ in the act of reversing on June 20th.

The level error in the afternoon of September 16th was + 22·4″, and the eastern pivot was raised until it became — 13·4″. In the afternoon of October 12th, it was + 15·1″ and the same pivot was raised until it became — 15·7″.

The caps covering the pivots were omitted to be removed before reversing the instrument on October 24th, and in attempting to raise it with the jack, the level error was changed from —16·4″ to — 0·8″.

Transits could not be observed with clamp E, on March 7th, and with it W. on April 20th.

The chronometer was allowed to run down on January 6th and was re-started with a small error. It ran down on November 17th and was re-started on the 19th.

After the first group of transits on December 31st, the instrument was adjusted for azimuth for the first time since June 24th, 1887. During this adjustment the level error was considerably changed.

Extra-Meridian Work.

OCCULTATIONS OF STARS BY THE MOON.—Notwithstanding the prevalence of cloudy weather, particularly at the beginning and the end of the year, no fewer than sixty-five phases were observed, namely, thirty-six disappearances at the dark and five reappearances at the bright limb, and ten disappearances at the bright and fourteen reappearances at the dark limb. The stars for fifty-nine of the phases have been identified by means of the catalogues in the Observatory library. Twelve *Nautical Almanac* stars were observed in both phases, and among them *Antares* on May 10. What may perhaps be regarded as a feat in occultation observation was accomplished on August 29. This was the observation of both phases of B.A.C. 6127, a star of the 5th magnitude, in full sunlight. A detailed account of the observation is given in the *Observatory* for November, 1895. The total number of occultation-phases observed here from 1864 inclusive to the end of 1895 is 692, comprising 605 disappearances and 87 reappearances. The results for 1895 have been forwarded to the *Astronomische Nachrichten*, and they present the greatest number obtained for any one year during the period just referred to. The occultation-series 1873-1876 was availed of by Professor Auwers in 1884 for the determination of a fundamental meridian for Australia. The series for 1864-70 is at present in the hands of another German astronomer, and the results are likely to be very satisfactory. It is hoped that the much longer series 1876-95, observed under better instrumental conditions, may soon be turned to similar account. Mr. Joseph Brooks, F.R.A.S., has kindly furnished the Observatory with predictions of occultations during the year and thus rendered it an important service.

CONJUNCTION OF JUPITER AND 1 GEMINORUM.—Filar-micrometer measures were made on the 8-inch equatorial on January 5 and 10 with satisfactory results. In consequence of cloudy weather there was no other opportunity for comparisons.

CONJUNCTIONS OF SATURN WITH κ AND 96 VIRGINIS.—These were observed in May and August respectively. Filar-micrometer comparisons on the 8-inch equatorial under good conditions were made on May 6, 7, 9, 13, 15, 16, and August 4, 8, 9, 10, 11, 12, and the resulting corrections of the *Nautical Almanac* ephemeris were found to be very consistent.

CONJUNCTION OF VENUS AND ϵ GEMINORUM.—Comparisons of these objects were made by means of the same telescope and micrometer in full sunlight on May 19 and 20, but in consequence of the unsteadiness and bad definition of the planet, the results are unsatisfactory and not worth publication.

MINOR PLANETS.—Dr. Luther of Düsseldorf kindly provided the Observatory with ephemerides of *Hebe* and *Parthenope* for the oppositions of February and January respectively. Continuous cloudy weather prevented any observation of the latter, but of the former a good series of comparisons with the filar-micrometer of the 8-inch equatorial was obtained on February 24, 25, 26, 27, March 4, 12, 13, 14, 24, 25, 28. A fine series of measures of *Ceres* with the same instrument was obtained on June 28, 29, 30, July 1, 2, 4, 5, 7, 8, 9, 12, 15, 16, 17, between the parallels of 27° and 29° south declination. The corrections for the ephemeris of this planet in the Appendix to the *Nautical Almanac* for 1895 are very satisfactory throughout the series.

COMETS.—There are no observations to record in this department. Owing to much cloudy weather in March Encke's comet could not be observed in the morning sky. A long period of cloudy weather in December also prevented any observation of the bright comets discovered by Perrine and Brooks. The telegrams announcing the discoveries of these comets were received respectively on November 19 and 26, with the respective positions for the 17th and 21st, but without any indication of the direction of motion. An opportunity did not present itself till the morning of December 2, civil time, and I then swept for Brooks' comet between 5° and 17° south declination and in strong moonlight, but without success. On the evening of the same day, in answer to enquiries, a telegram was received from the Melbourne Observatory giving the position for November 25, 644 G.M.T., from which it was quite obvious that the search was made too far south. Cloudy weather again set in and continued for some days. Towards the close of December a very brilliant comet was reported to have been seen low down on the south-west horizon at various places in New South Wales and Victoria. From an ephemeris by the Rev. G. M. Searle in No. 360 of the *Astronomical Journal*, received on the 9th instant, it is obvious that this brilliant object was no other than the comet discovered

by Perrine. It is much to be regretted that beyond the original announcement of the discovery of this comet no further particulars were cabled to Australia. Had the elements or a few ephemeris positions been furnished in time, it is probable that some positions might have been secured.

PHENOMENA OF JUPITER'S SATELLITES.—These were observed in February, March, April, and May, and are classified thus:—Transit ingress, I.3; Transit egress, I.2, III.1; Occultation disappearances, I.2, II.1; Occultation reappearances, III.1, IV.1; Eclipse disappearance, III.1; Eclipse reappearances, I.7, II.2, III.2, IV,1. The last mentioned phase occurred on April 11, and was an early eclipse of the present cycle for the fourth satellite. The apparent error of the *Nautical Almanac* was found to be +13m. 17s.

DOUBLE STARS.—The following southern double stars, all of which are of peculiar interest, were measured with the 8-inch equatorial:—*p Eridani, Lacaille* 2145, *Stone* 4019, δ *Argûs*, α *Crucis*, γ *Centauri*, γ *Virginis*, β *Muscæ*, α *Centauri*, π *Lupi*, ρ *Ophiuchi*, 36 *Ophiuchi*, *Brisbane* 6556, *Lacaille* 7924, γ *Coronæ Australis*, θ *Indi*, and θ *Gruis*. Forty-five nights were partially occupied with this department of work, and the measures involve 815 settings for position angle and 348 for distance. The results for α and γ *Centauri* and γ *Coronæ Australis* have been forwarded in advance of publication to Dr. See of Chicago, and those of α *Centauri* to Dr. Doberck of Hongkong, in accordance with applications from those astronomers.

VARIABLE STARS.—η *Argûs* was compared on two or three occasions and a connected series of comparisons of *R Carinæ* was obtained, from which it appears that the maximum of this interesting variable was attained on May 13=5.1 of the scale of the *Uranometria Argentina*. This exceeded the maximum of the preceding year by half a magnitude, and is the eleventh satisfactorily determined at Windsor since 1879. A comparison of the Cordoba observations in 1871 with those at Windsor in 1895 gives a mean period of about 311 days from maximum to maximum. This is a day less than that deduced from the comparisons down to 1886.

Meteorological Observations.

These observations have been carried on with great regularity at 9h. a.m., and comprise readings of the barometer, maximum and minimum dry and wet thermometers, black bulb sun thermometer *in vacuo* and grass radiation thermometer, also the indications of two rain-gauges and two evaporation-gauges at different heights. The direction of the wind is also continuously recorded by an anemograph constructed by the author, whose motive power for the cylinder carrying the register-sheet is an old English eight-day clock beating seconds. It may be interesting to note here that this timekeeper, which has been doing the work for the past sixteen years, was once the old family-clock by which the author of these pages learned to tell the time about fifty-five years ago. The abstracts of the meteorological observations for 1891, 1892, 1893, 1894 and 1895 are now nearly ready for the printer. The daily rainfall return has been forwarded in accordance with custom to the Government Astronomer. The winter of 1895 proved to be the severest experienced at Windsor since observations were commenced in 1863.

Publications.

The following papers have appeared in various scientific journals since the publication of the last report :—

RESULTS OF DOUBLE-STAR MEASURES IN 1894.—*Royal Astronomical Society's Monthly Notices,* vol. lv., p. 308.

EQUATORIAL COMPARISONS OF JUPITER AND 1 GEMINORUM, 1895, JAN. 5, 10.—*R.A.S. Monthly Notices,* vol. lv., p. 341.

OBSERVATIONS OF PHENOMENA OF JUPITER'S SATELLITES IN 1895.—*R.A.S. Monthly Notices,* vol. lv., p. 517.

RESULTS OF MICROMETER COMPARISONS OF SATURN AND κ VIRGINIS, 1895, MAY.—*R.A.S. Monthly Notices,* vol. lv., p. 519.

OBSERVATIONS OF THE OCCULTATION OF VENUS, 1894, MAY 1, AND OF OCCULTATIONS OF STARS DURING 1894.—*Astronomische Nachrichten,* Band cxxxvii., p. 397.

OBSERVATIONS OF MINOR PLANET (6) HEBE, 1895, FEBRUARY AND MARCH.—*Ast. Nach.,* Band cxxxviii., p. 283.

NOTE ON MR. C. J. MERFIELD'S PREDICTED OCCULTATION OF B.A.C. 5255 FOR 1895, JULY 3.—*British Astronomical Association Journal,* vol v., p. 510.

OBSERVATION OF THE OCCULTATION OF ANTARES, 1895, MAY 10.—*B. Ast. Assoc. Journal,* vol. v., p. 511.

OBSERVATION OF THE ECLIPSE OF JUPITER'S FOURTH SATELLITE, 1895, APRIL 11.—*Publications of the Astronomical Society of the Pacific,* vol. vii., No. 43, p. 218.

RESULTS OF FILAR-MICROMETER COMPARISONS OF SATURN WITH 96 VIRGINIS, 1895, AUGUST, AND OF CERES WITH NEIGHBOURING STARS, 1895, JUNE AND JULY.—*R.A.S. Monthly Notices,* vol. lvi., p. 38.

OBSERVATION OF A DAYLIGHT OCCULTATION OF B.A.C. 6127, 1895, AUGUST 29.—*Observatory,* vol. xviii., p. 396.

The Library.

A considerable number of books and pamphlets have been received during the year, for which the author tenders his best thanks to the various donors. A complete list of the presents for 1895 is appended to this report.

Personal Establishment.

All the astronomical and nearly all the meteorological observations have been made by the proprietor. During a day's absence from home, about once a fortnight, the latter observations have been made by his son. The astronomical reductions have been made by the author, and the sums and means of the meteorological observations have been computed independently by two other persons and finally examined by him.

Work Proposed for the Year 1896.

The observations of occultations and of the meteorological instruments, together with the author's attention to business of a private nature will probably occupy the first three months of the year. The programme for work after March is not yet settled, but it will probably be similar to that adhered to in former years.

1896, January 31.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1895.

[NOTE.—The names of the donors are printed in italics.]

Results of Rain, River, and Evaporation Observations in New South Wales during 1893; pp. l. and 176, with diagrams. Two copies.

Magnetic Storms and Sunspots, by M. A. Veeder. Sheet.

The Government Observatory, Sydney.

Record of Results of Observations in Meteorology and Terrestrial Magnetism at the Melbourne Observatory, &c., from April 1 to June 30, 1894; pp. 19.

Record of Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory, &c., from July 1 to Sept. 30, and from October 1 to December 31, 1894; pp. 35.

The Government Observatory, Melbourne.

Sixth International Congress of Geographical Societies. Invitation Circular; pp. 33.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, 1894-1895; vol. X., pp. 144.

The Queensland Branch of the Society.

"The Surveyor" for December 4, 1894, January 7, February 4, March 6, April 18, May 8, June 5, July 5, August 8, September 6, October 5, November 11, December 9, 1895.

The Institution of Surveyors, N. S. Wales.

Report of the Trustees of the Sydney Free Public Library for 1894; pp. 8.

The Trustees.

Catalogue of 1713 stars for 1885.0 from Observations at the Royal Observatory, Cape of Good Hope, 1879 to 1885, with two appendices; pp. 1 and 115.

Results of Meridian Observations of Stars at the Royal Observatory Cape of Good Hope from 1885 August to 1887 December; pp. xviii. and 412. *The Astronomer Royal for England.*

Cambridge Astronomical Observations, Vols. I. to XXII., 1828-1869.

The Cambridge University Observatory.

Catalogue of 6424 Stars for 1890.0 from Observations at the Radcliffe Observatory, Oxford, during 1880-1893; pp. xv. and 287.

The Radcliffe Trustees.

Weekly Weather Reports, October 27th, 1894, to November 23rd, 1895, both included with Title Page and Preface for 1894; Vol, XI., 3rd Series.

Summary of Observations at Stations included in the Daily and Weekly Weather Reports, September, 1894 to September, 1895, both included.

Quarterly Summary of Weekly Weather Reports, 1894 October-December, and 1895 January-March, April-June, and July-September.

Year's Summary of the Weekly Weather Report, 1894.

Appendix II., Vol. XI., Weekly Weather Report, Tables I. to VI.

Meteorological Observations at Stations of the Second Order for 1890.

Report of the Meteorological Council to the Royal Society for the Year ended March 31, 1894; pp. 102.

Report of the International Meteorological Committee, Upsala, 1894; pp. 48. *The Meteorological Office, London.*

Extracts from the Report of the Liverpool Observatory, Bidston, Birkenhead, with Meteorological Results during 1892 and 1893; pp. 60.

The Liverpool Observatory.

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, 1894; pp. 84.

Stonyhurst College Observatory.

Report of the Incorporated Kew Committee for 1894; pp. 33.

The Kew Observatory.

Report on the Temple Observatory, Rugby, for 1894; pp. 2.

The Temple Observatory.

Walsingham Observatory Report, 1894; pp. 2.

The Walsingham Observatory.

Meteorological Department, Borough of Southport. Report and Results of Observations for 1894, with two Appendices; pp. 32.

Fernley Observatory, Southport.

Meteorological Observations at Rousdon Observatory, Devon, for 1894; pp. 34. *The Rousdon Observatory.*

Report of H.M. Astronomer at the Cape of Good Hope for 1894; pp. 20.

The Royal Observatory, Cape of Good Hope.

Madras Meridian Circle Observations, 1883-84-85-86-87; Vol. VIII., pp. xxii. and 150.

List of Errata in Vols. I. to VI. Madras Meridian Circle Observations.

The Madras Observatory.

Monthly Weather Review, Meteorological Service, Dominion of Canada, April, May, June, July, September, October, November, December, 1894, and January, February, March, April, 1895.

Toronto General Meteorological Register for 1894; pp. 11.

The Meteorological Office, Toronto.

Observations and Researches at Hongkong Observatory in 1894; pp. 44 and 108. *The Hongkong Observatory.*

Extract from the Annual Report of the Superintendent of the Nautical Almanac for 1894; pp. 7.

The Elements of the Four Inner Planets. and the Fundamental Constants of Astronomy, by S. Newcomb; pp. 202.

Office of the American Ephemeris.

A Brief Account of the Lick Observatory of the University of California, by E. S. Holden; 2nd Edition, pp. 29, with plates.

Report on the Total Eclipse of the Sun at Mina Bronces, Chili, 1893, April 16, by J. M. Schaeberle; pp. 126, with plates.

The Lick Observatory.

Annals of the Astronomical Observatory of Harvard College, Vol. XXXII., Part I. Investigations of Astronomical Photography, by Prof. W. H. Pickering; pp. 115 and 7 plates.

Harvard College Observatory.

Observations during 1889 at the U .S. Naval Observatory; pp. lxvii., 111, 51, with an appendix, pp. 73.

Meteorological Observations and Results at the U. S. N. Observatory, 1889; pp. 57.

Magnetic Observations at the U. S. N. Observatory, 1892; pp. 73.

The U. S. Naval Observatory.

Report of the Yale University Observatory for 1894-95; pp. 21.

The Yale University Observatory.

Publications of the Washburn Observatory, Vol. VII., Part 2. Meteorological Observations, 1890-91-92-93; pp. 105.

The Washburn Observatory.

Publications of the Cincinnati Observatory (No. 13). Catalogue of 2000 Stars for 1890; pp. 51. *The Cincinnati Observatory.*

Proceedings of the Section of Engineers and Naval Architects of the Franklin Institute, 1894; pp. 145, with plates.

The Natural Soda Deposits of the United States, by Dr. T. M. Chatard; pp. 22.

The City Avenue Bridge over the Schuylkill River, Philadelphia, by J. V. Merrick; pp. 6, with diagrams.

The Theory of the Air-lift Pump, by E. G. Harris; pp. 21.

Reasons for Predicting the Existence of Argon, by C. J. Reed; pp. 9, with illustrations.

Investigation of Utah Gilsonite, a Variety of Asphalt, by W. C. Day; pp. 17.

Asphalts and Bitumens, by S. P. Sadtler, Ph.D.; pp. 15.

An Apparatus for Experimenting with the Law of Flexure of Beams; pp. 5.

The Franklin Institute, Philadelphia.

The Parallax of η *Cassiopeiæ*, deduced from the Rutherford Photographic Measures, by H. S. Davis; pp. 25.

Columbia College Observatory.

Rapport Annuel sur l'Etat de l'Observatoire de Paris, pour 1894; pp. 30
The Paris Observatory.

Annales de l'Observatoire de Nice, Tomes IV. & V.
The Nice Observatory.

Mittheilungen der Hamburger Sternwarte, Nos. 1 and 2; pp. 62 and 41.
Sternwarte Hamburg bericht des Direktors, Prof. G. Rümker; pp. 7.
The Hamburg Observatory.

Publicationen der v'Kuffner'schen Sternwarte in Wien, III. Band; pp. xvi., 307, with Appendices; pp. xcvi.
v'Kuffner's Observatory, Vienna.

Meteorologische und Magnetische Beobachtungen zu Pola, Jän.—Sept., 1895. *Hydrog. Amte zu Pola*

Magnetische und Meteorologische Beobachtungen an der k. k. Sternwarte zu Prag, 1894. *The Prague Observatory.*

Az Utolso 15 ev Az Ustokösök törteneteböl (1880-1895), &c.; pp. 25 and 11, with diagrams. *Kiskartel Observatory.*

Sulla Teoria dei Cicloni recherche di Luigi de Marchi; pp. 44, with plates.
The Observatory, Brera, Milan.

Concours International de Reglage pour Chronometres de Poche de haute precision en 1896; pp. 7. *The Geneva Observatory.*

Publication der Charkower Universitäts-Sternwarte, Heft No. 3; pp. 72 and 23, with diagrams. *The Charkow Observatory.*

Resultate der Beobachtungen in Kazan betreffend der Veränderlichkeit der Polhöhe; pp. 85, with diagram. *The Observatory, Kasan.*

Redogörelse för fortgängen af de astrofotografiska arbetena å observatoriet i Helsingfors under tiden Juni, 1893—Maj, 1894 (pp. 10), and Juni, 1894, till Maj, 1895 (pp. 8), af Anders Donner.
The Observatory, Helsingfors.

Die Triangulation von Java, Vierte-Abtheilung, von Dr. J. A. C. Oudemans; pp. 224, with plates. *Die Niederlandischen Regierung.*

Annuario del Observatorio Ast. Nacional de Tacubaya, 1895; pp. 414.
Boletin del Observatorio Ast. Nacional de Tacubaya, Obs. Merid., Tomo I., Nos. 19, 20, 21, 22.
Tempestades del Fin del Invierno por Guillermo, B. Y. Puga; pp. 30, with diagrams *The Observatory, Tacubaya.*

Boletin del Observatorio Meteorologico Central del Estado de Vera Cruz, Xalapa, Mexico, Resumen de Enero & Febrero, Api de 1895, Resumen, etc., en cle Ano de 1894, April, Majo, Junio, 1895.
The Central Meteorological Observatory, Vera Cruz.

Annuario publicado pelo Observatorio do Rio de Janeiro, 1894; pp. 350.
The Imperial Observatory, Rio de Janeiro.

Memorias y Revista de la Sociedad Cientifica "Antonio Alzate," Tomo VII., Nos. 11, 12, Tomo VIII., 1894-95, Nos. 1, 2, 3, 4.
Sociedad Cientifica, "Antonio Alzate."

A Survey of Recent Exploration in British New Guinea, by J. P. Thomson, F.R.S.G.S.; pp. 17.
The Physical Geography of Australia, by the same; pp. 47.
The Author.

A List of Probably New Double Stars, by R. T. A. Innes, F.R.A.S.
The Author.

Chairman's Address, by B. C. Simpson, M.Inst.C.E., before Engineering Section of the Royal Society of N. S. Wales, May 15th, 1895; pp. 7. *The Author.*

Light as the Interpretation of the Law of Gravity, by A. M. Cameron; pp. 54. *The Author.*

Paper on Aeronautical Work, pp. 8, with plates, i.-ix., by Lawrence Hargrave. *The Author.*

The Cubic Parabola as Applied to the Easing of Circular Curves, on Railway Lines, by C. J. Merfield; pp. 26, with plate.
The Author.

The History, Theory, and Determination of the Viscosity of Water by the Efflux Method, by G. H. Knibbs; pp. 70, with plate.
The Author.

Note on Stars Suitable for the Determination of Clock Errors, by A. M. W. Downing, M. A.; pp. 3, with plate. *The Author.*

Data for Computing the Positions of the Satellites of Jupiter, 1894-95; pp. 7, by A. Marth.

Ephemeris for Physical Observations of Jupiter, 1894–95 (concluded); pp. 9, by A. Marth.

Ephemerides of the Five Inner Satellites of Saturn, 1895, by A. Marth; pp. 9.

Ephemeris for Physical Observations of Jupiter, 1895-96, by A. Marth; pp. 9 and 15.

Data for Computing the Positions of the Satellites of Jupiter, 1895-96, by A. Marth; pp. 8. *The Author.*

Remarkable Comets, by W. T. Lynn, F.R.A.S., 3rd ed. *The Author.*

Spectroscopic Binary Stars, by J. E. Gore, F.R.A.S.; pp. 4. Two copies.
The Author.

The Brunsviga Calculating Machine. *The Publishers.*

On a Method of Photographing the Corona during a Total Eclipse, &c., by C. Burckhalter; pp. 5. *The Author.*

The Rutherfurd Photographic Measures of Sixty-two Stars about η *Cassiopeiæ*, by H. S. Davis; pp. 40. *The Author.*

Magnetic Storms and Sunspots, by M. A. Veeder, sheet. Three copies.
The Author.

Mesures Micrometriques d'Etoiles-Double faites a l'Observatoire de Paris, 1890 à 1894, par M. G. Bigourdan. *The Author.*

Détermination des Constantes Necessaires pour la Réduction des Clichés pris à Helsingfors pour la construction de Catalogue Photographique des Etoiles jusqu'à la Onzième grandeur, par Anders Donner; pp. 68. *The Author.*

Le Service Chronometrique a l'Observatoire de Genève, etc., par Raoul Gautier; pp. 171. *The Author.*

Elemente und Ephemeride des Planeten *Geraldina* (300) für die Opposition, 1895, von A Rodin; pp. 6. *The Author.*

Beobachtung heller Linien in den Spektren einiger Sterne, von G. Gruss und W. Láska; pp. 2.

Untersuchungen über den Lichtwechsel von veränderlichen Sternen, von G. Gruss und W. Láska; pp. 6. *The Authors.*

Im Reiche des Lichtes, Sonnen, Zodiakallichte, Kometen, etc., von Hermann Gruson, pp. 263, with coloured and other plates. *The Author.*

Beobachtungen Veränderlichen Sterne angestellt von J. Plassman, Vierter Teil; pp. 52, with diagrams. *The Author*

Jena, Sonder-Abdruck aus V.J.S. der Ast. Gesellschaft, Jahrgung 27, Heft 2 und Jahrgung 28, Heft 3. *Otto Knopf.*

L~~a~~e Phenomène Fondamental du Systeme Solaire, par A. Tischner; pp. 48. *The Author.*

ERRATA.

In the Report for 1894—

Page 15, line 6 from bottom, *for* 1894 *read* 1893.

Page 20, line 9 from bottom, *for* G. B. Jenkins *read* B. G. Jenkins.

Turner and Henderson, Printers, Sydney—3112.

Ann Arbor Observatory,
Michigan.
The United Sta

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1896,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association; Corresponding Member of the Alliance Scientifique of Paris; and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

Sydney:
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1897.

REPORT

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BY

JOHN TEBBUTT,

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CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY

For 1896.

THE year 1896 having been characterised by a very large number of clear nights, I am enabled to present an unusually good report of work done.

Buildings and Instruments.

No additions have been made either to the buildings or to the instruments during the year.

Position of the Observatory.

The longitude of the Observatory hitherto adopted is 10h. 3m. 20·5s. E. of Greenwich, and is derived in the manner described on pages 6 and 7 of the Report for 1888. The following is a summary of the best values obtained for this element :—

	h.	m.	s.
The Author's determination in 1880 from 23 occultation-phases during the period 1866-76. *R.A.S. Monthly Notices*, Vol. XL, p. 440.	10	3	21·81
Longitude of Sydney Observatory by Russell from moon-culminations in 1863, 1871-72-73-74 (See *Sydney Obs. 1877 and 1878*)=10h. 4m. 50·81s. E. *minus* difference of longitude by telegraph in 1885 and 1887=1m. 29·39s.	10	3	21·42

Longitude of Melbourne Observatory by Ellery from moon-culminations at Williamstown in 1860-61-62 (See Introduction to *Melbourne Obs.*, Vol. III., p. vi.)=9h. 39m. 54·80 *plus* difference of longitude by telegraph in 1887=23m. 25·87s.	10	3	20·67
Longitude of Sydney Observatory from telegraphic determinations in 1883=10h. 4m. 49·54s. E. *minus* 1m. 29.39s. referred to on page 3.	10	3	20·15
Longitude of Melbourne Observatory from telegraphic determinations in 1883=9h. 39m. 54·14s. *plus* 23m. 25·87s. above referred to.	10	3	20.01
Dr. Auwers' determination in 1884 from 75 occultation-phases observed at Windsor during 1873-76. See *Ast. Nach.*, Band 110, p. 339.	10	3	21·25
Dr. Auwers' determination in 1884 of the longitude of Melbourne Observatory from 12 occultation-phases observed at Melbourne in 1874-75 (See *Ast. Nach.*, Band 110, p. 339)=9h. 39m. 53·12s. E. *plus* 23m. 25·87s.	10	3	18·99
Dr. H. Clemens' determination in 1896 from 66 occultation-phases observed at Windsor during 1864-70. Inaugural dissertation.	10	3	20·60

The astronomical latitude is still adopted as—33° 36′ 30·8″, the value derived from prime vertical observations in 1881.

Meridian Work.

Sidereal chronometer *John Poole,* No. 2962, was employed as the timekeeper during the year and was regulated by means of the 3-inch transit instrument. A full explanation of the methods adopted for the determination of the errors of the transit instrument is given in the Report for 1890. In the early part of the year the equatorial distances in sidereal time of the outer wires of the instrument from the middle wire C were

adopted as :—A=+20·527s., B=+10·508s., D=−9·327s., E=−19·092s., with a correction of +0·523s. to the middle wire for the upper culmination, clamp east. These values were derived from a reduction of the circumpolar transits observed in 1895, and all the transits from the beginning of the year to April 22 were reduced to the middle wire by means of tables founded on them. It was found, however, on a reduction of the transits of circumpolar stars for this period that a change had taken place between January 11 and 27 in the distance of wire A from the middle wire. A provisional determination of the equatorial values of the wires was then made from the circumpolar transits from January 27 to April 22 with the following results:— A=+20·192s., B=+10·521s., D=−9·315s., E=−19·014s., with a correction of +0·477s. to the middle wire. These values were employed from April 22 to the end of the year. The reductions of the circumpolar transits were subsequently made to keep pace with the observations, but no further change occurred in the distances of the wires. The reductions from January 27 to the end of the year yielded the following values :— A=+20·191s., B=+10·502s., D=−9·319s., E=−19 014s., with a correction of +0·472s. to the middle wire. These will be employed for the current year. The fall observed in the eastern pivot during the year 1895 continued till about the middle of February, and from that time the pivot rose till May 7. It subsequently fell slowly till about June 25, when a very large and sudden fall occurred, with a large corresponding change in the azimuth. It then rose till the close of the year. With the exception of the sudden change of azimuth about June 25, this error did not vary much. After June 25 the north end of the axis of collimation moved very slowly eastward. During the year there were 536, 54 and 237 separate determinations of the level, collimation, and azimuth errors respectively. The local sidereal time was determined on 221 nights and for this purpose 1495 transits of stars were observed. Of these transits 1230 were of stars with a declination not exceeding 40° and 265 of stars in high declination for azimuth. The following table exhibits the errors of the transit instrument and the errors and rates of the chronometer *John Poole,* which was also employed in the extra-meridian observations. The apparent right ascensions of both clock and azimuth stars have been taken from the *American Ephemeris.*

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean o Transits.
			"	"	"		H. M.	M. S.	S.	S.
1896.										
Jan. 3	5	W.	+ 5.5	[+ 2.5]	+ 18.14	ξ^1 Ceti δ Hydri	2 2	2 30.56		
„ 3	6	W.	+ 6.1	[+ 2.5]	+ 19.34	30 Monocer., θ Chamæl.	8 1	2 31.18	0.104	0.10
„ 5	5	W.	+ 10.8	[+ 2.5]	+ 17.79 + 19.82	δ Hydri, ξ^2 Ceti μ Hydri, γ Ceti	2 52	2 35.06	0.090	0.11
„ 5	5	W.	+ 11·7	[+ 2.5]	[+ 18.8]		11 54	2 36.13	0.118	0.10
„ 6	3	W.	+ 18.4	[+ 2.5]	+ 18.50	η Tauri, γ Hydri	4 3	2 37.42	0.071	0.08
„ 9	4	W.	+ 28.7 − 10.7	[+ 2.6]	+ 17.55	ξ^1 Ceti, δ Hydri	1 59	2 46.68	0·132	0.11
„ 11	5	W.E.	+ 2.7	+ 2.6	+ 17.12	γ Hydri, A Tauri, W.	4 23	2 51.19	0.089	0.09
„ 22	2	E.	+ 20.0 − 19.5	[+ 1.5]	[+ 15.4]		3 30	3 19.01	0.106	0.08
„ 23	4	E.	− 16.4	[+ 1.4]	+ 15.22	η Tauri, γ Hydri	3 26	3 20.95	0.081	0.08
„ 27	5	E.W.	− 14.4	+ 1.0	+ 17.62	η Tauri, γ Hydri, E.	4 · 1	3 28.50	0.078	0.08
„ 28	4	W.	− 12.7	[+ 1.1]	+ 19.35	η Tauri, γ Hydri	3 42	3 30.50	0.084	0.09
„ 30	3	W.	− 12.3	[+ 1.3]	+ 16.84	ϵ Tauri, δ Mensæ	4 31	3 36.02	0.113	0.11
„ 31	3	W.	− 12.5	[+ 1.3]	[+ 17.5]		3 51	3 38.59	0.110	0.11
Feb. 3	5	W.E.	− 12.9	+ 1.6	+ 19.61	γ Hydri, γ Tauri, W.	4 32	3 47.23	0.119	0.15
„ 4	4	E.	− 13.8	[+ 1.5]	+ 17.13	ϵ Tauri, δ Mensæ	4 52	3 50.98	0.154	0.14
„ 5	3	E.	− 13.8	[+ 1.5]	[+ 17.6]		4 8	3 53.88	0.124	0.12
„ 16	2	E.	− 5.9	[+ 0.7]	[+ 22.9]		4 23	4 19.45	0.097	0.07
„ 18	7	E.W.	− 6.9	+ 0.6	+ 23.90	δ Doradûs, α Orionis, W.	5 11	4 22.73	0.067	0.07
„ 19	7	W.	− 5.7	[+ 0.8]	+ 24.36 + 22.14	δ Doradûs, α Orionis γ Geminorum ζ Mensæ	6 4	4 24.44	0.069	0.06
„ 20	6	W.	− 6.8	[+ 1.0]	+ 21.72	γ Geminorum, ζ Mensæ	5 37	4 25.69	0.058	0.06
„ 22	4	W.	− 7.5	[+ 1.5]	[+ 22.2]		5 10	4 29.04	0.070	0.07

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors.			Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			Level.	Collimation.	Azimuth.					
1896			"	"	"		H. M.	M. S.	S.	S.
Feb. 27	9	W.E.	− 8.8	+ 2.6	+ 23.21 + 23.77	δ Doradûs, α Orionis, E. γ Gemin., ζ Mensæ, E.	5 25	4 39.47	0.087	0.08
„ 29	8	E.	− 8.1	[+ 2.3]	+ 22.29	δ Doradûs, α Orionis	5 33	4 43.06	0.075	0.08
March 1	5	E.	− 9.0	[+ 2.2]	+ 24.36	δ Doradûs, α Orionis	5 29	4 45.18	0.089	0.08
„ 3	4	E.	− 11.1	[+ 2.0]	[+ 23.9]		5 31	4 48.47	0.068	0.07
„ 4	5	E.	− 12.3	[+ 1.8]	+ 23.59	δ Doradûs, α Orionis	5 36	4 50.22	0.073	0.08
„ 5	3	E.	− 12.3	[+ 1.7]	[+ 25.3]		5 46	4 52.17	0.081	0.07
„ 6	8	E.W.	− 15.5	+ 1.6	+ 26 97	γ^2 Piscis Vol., δ Gem. W.	6 4	4 53.79	0.067	0.07
„ 6	6	W.	− 14.9	[+ 1.6]	+ 24.30	α Apodis, δ Bootis	15 27	4 54.50	0.076	0.07
„ 7	4	W.	− 15.6	[+ 1.7]	+ 25.68	ε Geminorum, ζ Mensæ	7 29	4 55.57	0.067	0.07
„ 8	4	W.	− 17.7	[+ 1.9]	+ 27.05	σ Octantis, S.P.	5 33	4 57.35	0.081	0.08
„ 11	2	W.	− 26.5 − 0.7	[+ 2.3]	[+ 27·2]		7 33	5 4 31	0.094	0.09
„ 14	2	W.	− 3.6	[+ 2·7]	[+ 27.4]		7 35	5 10.04	0.080	0.09
„ 16	10	W.E.	− 7.1 + 1.1	+ 3.0	+ 26.47 + 28.49 − 3.42	ζ Mensæ, ζ Gemin., W. γ^2 Piscis Vol., δ Gem. E. 30 Mono., θ Cham. E.	7 48	5 14.65	0 096	0.10
„ 17	4	E.	+ 0.5	[+ 2.9]	− 4.38	γ^2 Piscis Vol., δ Gemin.	7 8	5 17.14	0.107	0.10
„ 20	4	E.	− 1.2	[+ 2.8]	− 3.14	ρ Leonis, δ^2 Chamæl.	10 13	5 23.96	0.091	0.09
„ 21	5	E.	− 1.7	[+ 2.7]	− 1.56 − 1.62	ε Geminor., ζ Mensæ σ Octantis, S.P.	6 55	5 25.84	0.091	0.10
„ 22	2	E.	− 2.1	[+ 2.7]	[− 2.8]		5 52	5 28·44	0.113	0.11
„ 23	6	E.W.	− 5.0	+ 2.6	− 2.20	σ Octantis, S.P., E.	7 47	5 31.20	0.107	0.11
„ 26	1	W.	− 6.3	[+ 1.4]	[− 1.3]		9 28	5 38.57	0.100	0.09
„ 27	10	W.E.	− 7.5	+ 1.0	− 1.13	30 Mono., θ Chamæl., W.	9 28	5 40.64	0.086	0.07
„ 28	4	E.	− 8.9	[+ 1.1]	− 2.57	σ Octantis, S.P.	7 14	5 41.98	0.062	0.08

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			″	″	″		H. M.	M. S.	S.	S.
Mar. 29	3	E.	− 10.8	[+ 1.2]	− 2.10 − 2.32	θ Geminorum, ζ Mensæ σ Octantis, S.P.	7 13	5 44.11	0.089	0.09
„ 30	2	E.	− 11.8	[+ 1.4]	+ 0.12	γ^2 Piscis Vol., β Canis Min.	7 33	5 46.55	0.100	0.11
April 1	10	E.W.	− 17.8 + 10.1	+ 1.6	+ 0.54 − 2.41	θ Hydræ, β Argûs, E. η Octantis, δ Leonis, W.	10 51	5 53.28	0.131	0.10
„ 2	5	W.	+ 9.2	[+ 1.8]	− 1.01 − 0.07	θ Geminorum, ζ Mensæ σ Octantis, S.P.	6 50	5 54.82	0.077	0.09
„ 4	7	W.	+ 3.5	[+ 2.0]	− 1.20 + 0.67	θ Geminorum, ζ Mensæ σ Octantis, S.P.	6 27	6 0.37	0.117	0.12
„ 5	3	W.	+ 1.2	[+ 2.2]	[+ 0.9]		6 43	6 3.24	0.118	0.13
„ 5	8	W.E.	+ 1.0	+ 2.2	− 0.82 + 1.96	α Apodis, ϵ Bootis, W. ϵ Serpen., δ^1 Apodis, E.	15 29	6 4.41	0.133	0.13
„ 6	8	E.	− 3.0	[+ 2.1]	+ 3.44	θ Chamæl., η Cancri	6 34	6 6.81	0.126	0.13
„ 8	4	E.	− 6.3	[+ 1.9]	+ 4.12	β Cancri, θ Chamæleontis	8 10	6 14.15	0.158	0.15
„ 9	6	E.	− 13.2 + 14.0	[+ 1.8]	+ 5.78	β Cancri, θ Chamæleontis	7 9	6 17.46	0.144	0.17
„ 10	1	E.	+ 13.1	[+ 1.7]	[+ 5.2]		8 27	6 22.37	0.194	0.19
„ 11	6	E.W.	+ 10.7	+ 1.6	+ 4.55	γ^2 Piscis Vol., δ Gemin., W.	7 1	6 26.53	0.184	0.20
„ 12	6	W.	+ 10.4	[+ 1.7]	+ 3.60	γ^2 Piscis Vol., δ Geminor.	6 57	6 31.72	0.217	0.20
„ 13	4	W.	+ 7.4	[+ 1.8]	+ 3.32	γ^2 Piscis Vol., δ Geminor.	7 24	6 35.95	0.178	0.19
„ 14	5	W.	+ 3.9	[+ 2.0]	+ 4.10	γ^2 Piscis Vol., δ Geminor.	7 0	6 40.62	0.198	0.18
„ 15	5	W.	+ 2.9	[+ 2.1]	+ 3.76	γ^2 Piscis Vol., δ Geminor.	7 0	6 44.33	0.155	0.15
„ 16	7	W.E.	+ 0.8	+ 2.2	+ 4.44 + 4.93	γ^2 Piscis Vol., δ Gem., W. θ Chamæl., α Lyncis, E.	7 44	6 47.82	0.141	0.15
„ 17	3	E.	− 0.8	[+ 2.3]	+ 4.61	γ^2 Piscis Vol., δ Geminor.	7 11	6 51.39	0.152	0.13
„ 18	3	E.	− 2.5	[+ 2.3]	+ 4.89	γ^2 Piscis Vol., δ Geminor.	7 11	6 53.88	0.102	0.11

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			″	″	″		H. M.	M. S.	S.	S.
April 19	3	E.	− 4.9	[+ 2.4]	+ 5.00	γ^2 Piscis Vol., δ Geminor.	7 11	6 56.47	0.110	0.11
,, 20	6	E.W.	− 7.3	+ 2.4	+ 1.79	ζ Chamæl., μ Leonis, W.	9 10	6 59.28	0.108	0.11
,, 22	6	W.	− 7.9	[+ 2.0]	− 0.38	η Octantis, δ Leonis	10 49	7 4.63	0.108	0.11
,, 23	6	W.	− 11.6	[+ 1.8]	+ 2.42	41 Leonis Min., δ^2 Chamæl.	9 2	7 7.02	0.108	0.13
,, 24	2	W.	− 15.6	[+ 1.6]	[+ 3.3]		7 38	7 10.40	0.150	0.14
,, 25	10	W.E.	− 17.1 + 14.8 + 12.3	+ 1.4	+ 6.91 + 4.63 + 0.87	κ Cancri, β Argûs, W. ζ Chamæl., μ Leonis, W. η Octantis, δ Leonis, E.	9 59	7 13.89	0.132	0.14
,, 26	5	E.	+ 11.3	[+ 1.5]	− 0.18 + 1.36	41 Leonis Min., δ^2 Cham. η Octantis, δ Leonis	11 5	7 17.47	0.143	0.15
,, 27	5	E.	+ 9.1	[+ 1.6]	+ 4 27	γ^2 Piscis Vol., δ Geminor.	7 20	7 20.73	0.161	0.13
,, 28	4	E.	+ 7.9	[+ 1.7]	[+ 4.1]		7 6	7 23.10	0.100	0.11
,, 30	5	E.	+ 5.2	[+ 1 8]	+ 3.76	10 Leonis Min., ζ Chamæl.	8 16	7 28.98	0.120	0.13
May 1	6	E.	+ 3.9	[+ 1.9]	+ 4.30	10 Leonis Min., ζ Chamæl.	8 38	7 32.23	0.133	0.13
,, 2	10	E.W.	+ 1.7	+ 2.0	+ 2.93 + 5.57	10 Leonis Min., ζ Cham., E. 41 Leonis Min, δ^2 Cham., W	9 59	7 35.19	0.117	0.13
,, 2	8	W.	+ 0.8	[+ 2.1]	+ 4.66	α Trianguli Aust. *d* Herc.	17 24	7 36.19	0.135	0.13
,, 3	5	W.	+ 0.1	[+ 2.3]	+ 4.60	41 Leonis Min, δ^2 Cham.	10 28	7 38.31	0.124	0.13
,, 4	7	W.	− 2.5	[+ 2.5]	+ 2.51	ζ Chamæl., μ Leonis	7 57	7 41.17	0.133	0.22
,, 4	10	W.E.	− 4.2	+ 2.6	+ 6.54 + 5.58	ζ Pavonis, ι Lyræ, E. σ Octantis, E.	17 46	7 43.69	0.257	0.25
,, 5	5	E.	− 5.2	[+ 2.2]	+ 2.17	δ^2 Chamæl., ρ^3 Leonis	8 29	7 47.05	0 228	0.24
,, 6	5	E.	− 5.7	[+ 1.9]	+ 3.30	41 Leonis Min., δ^2 Cham.	9 28	7 53.43	0.255	0.23
,, 7	7	E.	− 6.0	[+ 1.5]	+ 1.32	46 Leonis Min., η Octantis	9 29	7 58.41	0.207	0.18
,, 8	5	E.	− 4.6	[+ 1.2]	+ 4.55	β Cancri, θ Chamæleontis	8 8	8 1.96	0.157	0.14
,, 9	7	E.W.	− 4.1	+ 0.8	+ 3.72	β Cancri, θ Chamæl., E.	8 30	8 5.09	0.128	0.13

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.		No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
				"	"	"		H.	M.	M.	S.	S.	S.
1896.													
May	10	2	W.	—3.2	[+ 0.9]	[+ 4.4]		10	0	8	8.30	0.126	0.13
,,	12	4	W.	—2.4	[+ 1.7]	+ 5.63	30 Monocer., θ Chamæl.	8	16	8	14.85	0.142	0 17
,,	13	2	W.	—0.8	[+ 2.0]	[+ 4.6]		12	6	8	19.78	0.177	0.16
,,	14	3	W.	—1.5	[+ 2.3]	[+ 3.6]		7	40	8	22.57	0.143	0.14
,,	17	7	W.	—2.5	[+ 3.1]	+ 0.63	β Chamæleontis, β Hydri	11	45	8	31.40	0.116	0.10
,,	18	6	W.E.	—3.4	+ 3.4	— 0.55	ζ Chamæl , Regulus, W.	9	39	8	33.36	0.089	0.10
,,	19	9	E.	—3.9	[+ 3.1]	+ 5.17 — 0.68	β Chamæleontis, β Hydri α Canum Ven., δ Muscæ	10	33	8	35.95	0.104	0.10
,,	20	6	E.	—3.5	[+ 2.8]	+ 2.89	β Chamæleontis, β Hydri	11	55	8	38.15	0.087	0.09
,,	22	8	E.	—3.5	[+ 2.2]	+ 0.72 + 1.57	γ¹ Leonis, δ² Chamæl. β Chamæl., β Hydri	12	8	8	42.50	0.090	0.09
,,	25	7	E.W.	—4.0	+ 1.4	+ 0.47 — 0.52	41 Leonis Min., δ² Cham. E. η Octantis, δ Leonis, E.	11	42	8	49.48	0.098	0.11
,,	26	7	W.	—3.7	[+ 1.5]	+ 0.65 + 1.26	η Octantis, δ Leonis η Bootis, θ Apodis	12	43	8	52.38	0.116	0.11
,,	27	4	W	—4.2	[+ 1.6]	+ 0.01	10 Leonis Min., ζ Cham.	10	4	8	54.51	0.100	0.10
,,	28	9	W.	—3 2	[+ 1.8]	— 0.19	β Octantis, λ Pegasi	22	44	8	58.22	0.101	0.09
,,	29	8	W.	—3.1	[+ 1.9]	— 2.59	ε Delphini, β Pavonis	20	10	8	59.79	0.073	0.08
,,	30	10	W.E.	—4.5	+ 2.0	— 2.83 + 1.59	41 Leonis Min., η Octan., W β Chamæleontis, β Hydri, E	11	13	9	1.22	0.095	0.10
June	1	4	E.	—1.4	[+ 2.0]	— 3.75	η Octantis, δ Leonis	11	32	9	7.13	0.122	0.11
,,	2	3	E.	—0.8	[+ 2.0]	[— 3.8]		14	15	9	9.89	0.103	0.10
,,	5	4	E.	—0.1	[+ 2.0]	— 3.84	η Octantis, ν Ursæ Majoris	11	33	9	15.28	0.078	0.09
,,	10	6	E.W.	+0.7	+ 2.0	— 3.44	β Chamæleontis, β Hydri E	12	34	9	26.97	0.097	0.07
,,	11	3	W.	+0.5	[+ 2.1]	— 3.85	β Chamæleontis, β Hydri	12	10	9	28.51	0.065	0.07

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			"	"	"		H. M.	M. S.	S.	S.
June 13	3	W.	+ 5.1	[+ 2.3]	+ 0.13	β Chamæleontis, β Hydri	12 10	9 32.06	0.074	0.08
„ 14	3	W.	+ 6.0	[+ 2.4]	— 2.79	46 Leonis Min., η Octantis	10 55	9 34.03	0.089	0.10
„ 15	3	W.	+ 6.8	[+ 2.6]	[— 2.2]		11 31	9 36.95	0.119	0.11
„ 16	3	W.	+ 7.6	[+ 2.7]	[— 1.5]		12 32	9 39.40	0.098	0.09
„ 17	10	W.E.	+ 7.8	+ 2.8	— 1.23 — 0.55	β Chamæl., β Hydri, W. κ Octantis, η Bootis, E.	12 35	9 41.53	0.089	0.12
„ 18	5	E.	+ 8.9	[+ 2.5]	[+ 0.2]		10 16	9 44.69	0.146	0.13
„ 19	5	E.	+ 7.7	[+ 2.1]	+ 1.35	β Chamæleontis, β Hydri	13 16	9 47.89	0.119	0.11
„ 20	8	E.W.	+ 9.8	+ 1.8	— 1.15 + 1.93	κ Octantis, η Bootis, E. δ Octantis, ρ Bootis, W.	14 31	9 50.30	0.095	0.10
„ 21	4	W.	+ 10.3	[+ 1.9]	+ 0.30	β Chamæleontis, β Hydri	12 50	9 52.72	0.108	0.11
„ 25	8	W.E.	+ 93.4 — 9.0	+ 2.2	— 18.17 — 21.90 — 18.13	α Canum Ven. δ Muscæ W δ Octantis, ρ Bootis, W. δ Bootis, ρ Octantis, E.	14 41	10 3.19	0.107	0.09
„ 26	2	E.	— 8.1	[+ 2.2]	[— 20.2]		11 30	10 4.91	0.083	0.10
„ 27	5	E.	— 5.6	[+ 2.3]	— 21.03	β Chamæleontis, β Hydri	12 32	10 7.68	0.111	0.11
„ 28	2	E.	— 6.3	[+ 2.3]	[— 20.5]		13 11	10 10.73	0.124	0.13
„ 30	2	E.	— 8.8	[+ 2.5]	[— 19.3]		11 48	10 17.39	0.143	0.15
July 2	3	E.	— 7.4	[+ 2.6]	— 18.15	β Chamæleontis, β Hydri	12 11	10 24.92	0.156	0.14
„ 4	4	E.	— 9.3	[+ 2.6]	— 17.74	β Chamæleontis, β Hydri	12 7	10 31.10	0.129	0.13
„ 6	6	E.W.	— 12.3	[+ 2.7]	— 16.34	β Chamæleontis, β Hydri	13 56	10 37.32	0.125	0.13
„ 13	6	W.E.	— 19.1 + 4.0 + 1.0	+ 3.0	— 17.11 — 14.78	d Bootis, δ Octantis, W. δ Bootis, ρ Octantis, W.	15 15	11 5.96	0.169	0.19
„ 14	5	E.	+ 2.6	[+ 2.8]	— 14.47	η Bootis, θ Apodis	13 0	11 10.09	0.190	0.18
„ 15	3	E.	+ 2.7	[+ 2.7]	— 12.61	ϵ Serpentis, δ^1 Apodis	16 4	11 14.83	0.175	0.17

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			"	"	"		H. M.	M. S.	S.	S.
July 18	6	E.	— 0.3	[+ 2.2]	— 11.52	ε Serpentis, δ^1 Apodis	15 54	11 25.22	0.145	0.10
„ 19	10	E.W.	— 0.7	+ 2.0	— 21.10 — 16.81 — 15.14	δ Muscæ, θ Virginis, E. κ Octantis, η Bootis E. ε Cor. Bor., δ^1 Apodis, W	15 8	11 27.24	0.087	0.10
„ 21	8	W.E.	— 0.9	+ 2.0	— 14.59	α Apodis, ε Bootis, W.	16 9	11 32.88	0.115	0.11
„ 22	6	E.	— 1.6	[+ 2.1]	— 15.23 — 14.90	ρ Bootis, α Apodis ρ Octantis, α Cor. Bor.	16 0	11 35.32	0.102	0.12
„ 23	5	E.	— 1.1	[+ 2.2]	— 14.17	δ Bootis, ρ Octantis	14 0	11 38.41	0.140	0.14
„ 25	6	E.W.	— 0.2	+ 2.4	— 14.72 — 14.31	ρ Octantis, α Cor. Bor., E ε Cor. Bor., δ^1 Apodis, W.	16 0	11 44.87	0.129	0.11
„ 26	2	W.	— 1.8	[+ 2.4]	[— 14.6]		13 45	11 47.12	0.108	0.09
„ 27	4	W.	— 2.3	[+ 2.4]	— 14.75	η Bootis, θ Apodis	13 46	11 48.80	0.070	0.11
„ 28	5	W.	— 2.2	[+ 2.4]	— 14.22	δ Bootis, ρ Octantis	14 5	11 52.21	0.140	0.13
„ 29	3	W.	+ 1.7	[+ 2.4]	[— 14.0]		15 55	11 55.55	0.129	0.12
„ 31	7	W.E.	— 2.7	+ 2.4	— 13.67	δ Bootis, ρ Octantis, W.	14 56	12 0.82	0.112	0.13
Aug. 1	3	E.	— 2.9	[+ 2.4]	[— 13.3]		13 45	12 3.84	0.132	0.13
„ 2	4	E.	+ 0.8	[+ 2.5]	— 13.01	d Bootis, δ Octantis	14 1	12 7.04	0.132	0.16
„ 3	5	E.	— 2.9	[+ 2.5]	— 13.52	d Bootis, δ Octantis	14 26	12 11.52	0.184	0.17
„ 4	5	E.	— 3.4	[+ 2.5]	— 12.54	ε Cor. Bor., δ^1 Apodis	15 11	12 15.45	0.159	0.16
„ 5	1	E.	— 4.2	[+ 2.6]	[— 13.8]		18 28	12 19.64	0.154	0.15
„ 6	7	E.W.	— 6.0	+ 2.6	— 15.06	δ^1 Apodis, τ Herculis, E	15 42	12 22.80	0.149	0.14
„ 7	8	W.	— 8.0	[+ 2.7]	— 14.43	α Apodis, ε Bootis	14 16	12 25.86	0.136	0.13
„ 8	8	W.	— 8.3	[+ 2.7]	[— 14.5]		17 34	12 29.21	0.123	0.11
„ 9	2	W.	— 9.3	[+ 2.8]	[— 14.5]		17 20	12 31.51	0.097	0.10
„ 11	4	W.	— 10.5	[+ 2.9]	— 14.54	ε Cor. Bor., δ^1 Apodis	16 10	12 37.13	0.120	0.11
„ 12	10	W.E.	— 11.7	+ 3.0	— 17.52	γ Apodis, β Herculis, W.	16 25	12 39.76	0.108	0.11

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			″	″	″		H. M.	M. S.	S.	S.
Aug. 15	2	E.	—14.7	[+ 2.4]	[—11.3]		18 0	12 48.43	0.118	0.12
„ 16	8	E.	—15.6 +11.2	[+ 2.2]	— 9.18	γ Aquilæ, ε Pavonis	19 26	12 51.54	0.122	0.11
„ 17	3	E.	+10.8	[+ 2.0]	[—11.0]		15 11	12 53.62	0.106	0.11
„ 18	6	E.	+ 9.9	[+ 1.8]	—12.79	δ^1 Apodis, τ Herculis	15 21	12 56.29	0.110	0.14
„ 19	10	E.W.	+ 7.9	+ 1.6	—10.74	σ Octantis, W.	16 45	13 0.45	0.164	0.15
„ 20	9	W.	+ 7.1	[+ 1.7]	—10.01 —10.02	α Aquarii, υ Octantis η Aquarii, β Octantis	23 27	13 4.60	0.135	0.13
„ 21	6	W.	+ 6.4	[+ 1.7]	—11.75 —11.86	ζ Pavonis, β Lyræ σ Octantis	18 47	13 7.17	0.133	0.13
„ 22	10	W.E.	+ 5.1	+ 1.8	—12.11 —10.54 —11.63	α Trian.Aust., κ Oph., W γ Draconis, γ^2 Sagitt., E σ Octantis, E.	17 12	13 10.04	0.128	0.14
„ 23	7	E.	+ 4.7	[+ 2.1]	—12.07	ε Cor. Bor., δ^1 Apodis	15 51	13 13.40	0.148	0.14
„ 24	2	E.	+ 2.5	[+ 2.4]	[—10.8]		17 20	13 16.62	0.126	0.14
„ 26	8	E.W.	— 1.0 — 8.7	+ 3.0	— 8.20 — 8.50	β Chamæl., β Hydri, E. β Androm., κ Tucanæ, E	1 6	13 25.48	0.159	0.16
„ 29	4	W.	— 8.9	[+ 1.8]	—13.77	γ Draconis, γ^2 Sagittarii	17 52	13 35.99	0.162	0.17
„ 31	5	W.E.	— 9.9	+ 1.0	—11.31	σ Octantis, W.	19 37	13 44.34	0.168	0.16
Sept. 2	2	E.	—12.8	[+ 1.3]	[—10.8]		19 42	13 51.32	0.145	0.15
„ 4	5	E.	—16.0 + 8.4	[+ 1.6]	—10.31	σ Octantis	18 35	13 58.69	0.157	0.19
„ 5	4	E.	+ 9.7	[+ 1.7]	— 8.98	γ Draconis, γ^2 Sagittarii	18 30	14 3.69	0.209	0.19
„ 6	5	E.	+ 8.5	[+ 1.8]	— 8.89	γ Draconis, γ^2 Sagittarii	18 25	14 7.66	0.166	0.16
„ 9	4	E.	+ 3.4	[+ 2.3]	— 8.79 — 7.06	γ Draconis, γ^2 Sagittarii ζ Pavonis, β Lyræ	18 30	14 18.91	0.156	0.14

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			"	"	"		H. M.	M. S.	S.	S.
Sept. 10	8	E.W.	+ 1.3	+ 2.4	— 4.95 — 7.20	α Aquilæ, ε Pavonis, W. ε Delphini, β Pavonis, W.	19 10	14 22.16	0.132	0.13
„ 11	8	W.	+ 0.3	[+ 2.6]	— 6.32 — 7.95	ζ Pavonis, β Lyræ σ Octantis	19 13	14 25.42	0.136	0.15
„ 12	8	W.	— 2.9	[+ 2.7]	— 5.43 — 5.25	$α^1$ Herculis, ζ Pavonis ε Delphini, β Pavonis	18 28	14 29.08	0.157	0.17
„ 13	10	W.	— 6.2	[+ 2.8]	— 7.39 — 2.70	β Pavonis, ε Cygni 1 Pegasi, $λ^1$ Octantis	19 31	14 33.68	0.184	0.21
„ 14	12	W.E.	— 8.2	+ 3.0	— 6.09 — 3.01	σ Octantis, E. $λ^1$ Octantis, 16 Pegasi, E.	19 3	14 39.19	0.234	0.22
„ 15	8	E.	— 7.5	[+ 2.9]	— 4.83 — 7.26	β Herc., α Triang. Aust. σ Octantis	18 18	14 44.27	0.218	0.21
„ 17	6	E.	— 9.7	[+ 2.6]	— 2.12	ε Pavonis, γ Sagittæ	18 26	14 53.12	0.184	0.19
„ 20	8	E.	— 16.2 + 11.1	[+ 2.1]	— 8.13	σ Octantis	20 0	15 7.26	0.192	0.18
„ 21	10	E.W.	+ 8.6	+ 2.0	— 3.97	σ Octantis, E.	18 56	15 11.24	0.174	0.17
„ 21	5	W.	+ 8.2	[+ 2.0]	— 2.35	β Hydri, π Andromedæ	0 24	15 12.18	0.172	0.17
„ 22	2	W.	+ 6.6	[+ 1.9]	[— 2.0]		20 31	15 15.26	0.153	0.18
„ 23	2	W.	+ 5.1	[+ 1.8]	[— 1.6]		18 53	15 19.85	0.205	0.20
„ 26	6	W.E.	— 1.7	+ 1.6	+ 1.33 — 2.24	ζ Pavonis, β Lyræ, W. σ Octantis, W.	19 16	15 32.51	0.175	0.18
„ 27	5	E.	— 3.8	[+ 2.0]	— 2.78	σ Octantis	18 52	15 36.71	0.178	0.18
„ 28	6	E.	— 4.8	[+ 2.4]	— 3.37 + 1.26	σ Octantis δ Cygni. ε Pavonis	19 0	15 40.91	0.174	0.16
„ 28	13	E.W.	— 4.9	+ 2.4	— 0.37	ι Aurigæ, η Mensæ, E.	5 16	15 42.49	0.154	0.15
„ 29	6	W.	— 8.0	[+ 2.3]	— 2.43	σ Octantis	19 27	15 44.51	0.142	0.14

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			"	"	"		H. M.	M. S.	S.	S.
Sept. 30	3	W.	− 8.9	[+ 2.2]	− 1.12	σ Octantis	19 35	15 48.00	0.145	0.15
Oct. 2	3	W.	− 12.3	[+ 1.9]	− 0.50	σ Octantis	19 0	15 55.53	0.159	0.16
„ 3	9	W.E.	− 13.2	+ 1.8	+ 3.36 + 1.16	ζ Pavonis, β Lyræ, W. σ Octantis, W.	20 1	15 59.52	0.159	0.16
„ 5	4	E.	− 13.8	[+ 2.1]	+ 1.48 − 0.57	ζ Pavonis, β Lyræ σ Octantis	19 40	16 7.40	0.165	0.16
„ 8	2	E.	− 19.7 + 8.8	[+ 2.7]	− 2.91	ξ Aquarii, λ¹ Octantis	21 46	16 18.51	0.150	0.13
„ 9	6	E.	+ 6.2	[+ 2.8]	+ 2.61	ε Pavonis, γ Sagittæ	20 40	16 21.43	0.128	0.17
„ 10	7	E.W.	+ 2.4	+ 3.0	+ 3.76	λ¹ Octantis, 16 Pegasi, W.	20 20	16 26.46	0.212	0.22
„ 11	7	W.	+ 0.7	[+ 2.8]	+ 3.70 + 0.09	α Aquilæ, ε Pavonis α Aquarii, υ Octantis	20 16	16 32.07	0.234	0.23
„ 12	9	W.	+ 1.1	[+ 2.5]	+ 3.01	1 Pegasi, λ¹ Octantis	20 25	16 37.70	0.233	0.22
„ 16	8	W.E.	− 4.2	+ 1.6	+ 3.76	β Aquarii, λ¹ Octantis, E.	20 58	16 54.61	0.175	0.14
„ 17	8	E.	− 4.1	[+ 1.6]	+ 2.17 + 3.73	π² Pegasi, υ Octantis β Octantis, λ Pegasi	21 42	16 57.81	0.129	0.14
„ 19	10	E.	− 7.2	[+ 1.6]	+ 1.38	π² Pegasi, υ Octantis	20 34	17 4.71	0.147	0.20
„ 20	3	E.	− 9.4	[+ 1.6]	[+ 2.2]		19 34	17 9.84	0.223	0.21
„ 21	8	E.W.	− 9.8	+ 1.6	+ 3.05	1 Pegasi, λ¹ Octantis, W.	20 49	17 14.87	0.199	0.19
„ 22	3	W.	− 10.3	[+ 1.7]	[+ 3.7]		22 15	17 19.41	0.179	0.18
„ 24	5	W.	− 12.0	[+ 1.8]	+ 4.93	λ¹ Octantis, π² Cygni	21 15	17 28.49	0.193	0.19
„ 25	6	W.	− 13.3	[+ 1.9]	+ 5.59	λ¹ Octantis, π² Cygni	21 13	17 33.01	0.189	0.18
„ 27	4	W.	− 17.1 + 16.6	[+ 2.0]	+ 4.88	λ¹ Octantis, π² Cygni	21 45	17 40.34	0.151	0.16
Nov. 4	7	W.E.	+ 7.2	+ 2.6	+ 2.41 + 3.48	α Aquarii, υ Octantis, W. η Aquarii, β Octantis, E.	22 36	18 13.82	0.174	0.14

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			"	"	"		H. M.	M. S.	S.	S.
Nov. 5	2	E.	+ 6.0	[+ 2.7]	[+ 3.2]		22 2	18 17.11	0.140	0.16
„ 6	2	E.	+ 4.1	[+ 2.7]	[+ 3.4]		22 52	18 21.43	0.174	0.17
„ 7	5	E.	+ 3.9	[+ 2.8]	+ 3.63	η Aquarii, β Octantis	23 10	18 25.46	0.166	0.18
„ 8	2	E.	+ 2.2	[+ 2.8]	[+ 3.3]		22 27	18 30.01	0.195	0.20
„ 10	4	E.	— 2.4	[+ 2.9]	+ 2.74	η Aquarii. β Octantis	22 34	18 39 37	0.195	0.19
„ 11	10	E.W.	— 5.5	+ 3.0	+ 1.73 + 3.16	π² Pegasi, υ Octantis, E. γ¹ Octantis, ω Piscium W.	0 5	18 43.96	0.180	0.17
„ 12	10	W.	— 6.7	[+ 2.9]	+ 3.74	γ¹ Octantis, ω Piscium	23 23	18 47.49	0.152	0.15
„ 13	6	W.	— 7.0	[+ 2.8]	+ 2.35	λ Andromedæ, γ¹ Octantis	23 44	18 51.03	0.145	0.14
„ 21	6	W.E.	— 11.8	+ 2.0	+ 3.45	η Aquarii, β Octantis, W.	23 20	19 18.28	0.142	0.13
„ 22	5	E.	— 11 7	[+ 2.0]	+ 3.59	λ Andromedæ, γ¹ Octantis	23 18	19 21.44	0.182	0.18
„ 25	2	E.	— 11.5	[+ 2.0]	[+ 4.1]		1 0	19 29.55	0.112	0.11
„ 29	3	E.	— 12.4	[+ 2.0]	[+ 4.8]		1 27	19 40.65	0.114	0.13
Dec. 1	6	E.W.	— 14.2	+ 2.0	+ 5.09	γ¹ Octantis, α Androm., E.	0 45	19 46.88	0.132	0.12
„ 4	5	W.	— 14.9	[+ 1.9]	+ 6.28	β Chamæleontis, β Hydri	0 54	19 54.66	0.108	0.10
„ 5	5	W.	— 14.8	[+ 1.9]	+ 5.27	β Chamæleontis, β Hydri	0 32	19 56.97	0.098	0.10
„ 7	3	W.E.	— 14.2	+ 1.8	+ 6.22	α Andromedæ, β Hydri, W.	0 42	20 1.81	0.100	0.10
„ 8	10	E.	— 16.3	[+ 1.7]	+ 3.86	α Andromedæ, β Hydri	1 25	20 4.41	0.105	0.11
„ 9	7	E.	— 17.2	[+ 1.6]	+ 4.83 + 6.68	γ Trianguli, δ Hydri γ Trianguli, μ Hydri	1 51	20 7.05	0.108	0.11
„ 11	4	E.	— 17.0	[+ 1.5]	+ 3.06	β Hydri π Andromedæ	0 52	20 12.49	0.116	0.11
„ 12	4	E.	— 17.1	[+ 1.4]	[+ 3.9]		1 8	20 14.95	0.101	0.10
„ 13	1	E.	— 17.9	[+ 1.4]	+ 4.69	β Hydri, β Ceti	0 59	20 17.11	0.091	0.10
„ 15	7	E.W.	— 18.4 — 21.6 + 13.7	+ 1.2	+ 4.31 + 5.89 + 4.55	β Hydri, ε Piscium, E. μ Hydri, σ Arietis, E. β Persei, ι Hydri, W.	2 44	20 22.50	0.108	0.10

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1896.			"	"	"		H. M.	M. S.	S.	S.
Dec. 18	10	W.	+ 10.9	[+ 2.4]	+ 3.26 + 4.78	β Andromedæ, κ Tucanæ γ Hydri, c Persei	3 22	20 28.64	0.085	0.10
„ 21	6	W.E.	+ 8.1	+ 3.6	+ 3.10	β Androm., κ Tucanæ, W.	1 55	20 36.14	0.106	0.13
„ 22	7	E.	+ 6.0	[+ 3.1]	+ 6.44	μ Hydri, γ Ceti	1 57	20 39.31	0.132	0.13
„ 23	7	E.	+ 5.3	[+ 2.6]	+ 3.29	γ Trianguli, δ Hydri	1 53	20 42.39	0.129	0.12
„ 24	10	E.W.	+ 3.3	+ 2.0	+ 3.02 + 5.69	γ Trianguli, δ Hydri, W. μ Hydri, γ Ceti, W.	2 8	20 45.27	0.119	0.11
„ 25	4	W.	+ 1.7	[+ 2.1]	[+ 4.1]		1 52	20 47.57	0.097	0.09
„ 26	2	W.	+ 1.4	[+ 2.2]	[+ 3.9]		2 9	20 49.42	0.076	0.07
„ 27	2	W.	− 0.4	[+ 2.3]	[+ 3.7]		1 43	20 51.13	0.073	0.09
„ 31	6	W.E.	− 1.3	+ 2.6	+ 1.00 + 4.55	δ Hydri, σ Arietis, E. μ Hydri, ε Arietis, E.	2 46	21 4.36	0.136	

NOTES.

January 9th—The eastern pivot was raised to the extent of 39·4″ before the observations.

January 22nd—The eastern pivot was raised after the observations.

March 11th—The level error was —26·5″, and the eastern pivot was lowered before the observations.

March 16th—The azimuth was adjusted during the observations with clamp E. and the level error was in consequence considerably changed. The mean of the first set of level errors was employed in the reduction of the transits before this adjustment, and the mean of the second set in the reduction of the transits after the adjustment.

April 1st—The eastern pivot was lowered during the observations.

April 9th—The eastern pivot was lowered after the observations.

April 25th—The eastern pivot was lowered during the observations with clamp W. The level error was slightly changed in the act of reversal, and the later transits clamp W. and the transits clamp E. were reduced by the mean level errors before and after reversal, respectively.

June 25th.—An extraordinary fall of the eastern pivot occurred since the 21st and it was accordingly raised.

July 6th.—The collimation error was not recorded.

July 13th.—The eastern pivot was lowered during the observations clamp W., but the level error appears to have been slightly changed by the reversal.

August 16th.—The eastern pivot was lowered during the observations.

August 26th.—The level error was greatly changed in the act of reversing. The transits, with the clamp east and west, were reduced by means of two separate determinations of the level error.

September 4th and 20th.—The eastern pivot was lowered during the observations.

October 8th.—The eastern pivot was lowered before the observations.

October 27th.—The eastern pivot was lowered during the observations.

December 7th.—Observations could not be made with clamp E.

December 15th.—The level error was slightly changed by the reversal. The eastern pivot was lowered during the observations with clamp W.

Extra-Meridian Work.

OCCULTATIONS OF STARS BY THE MOON:—The results in this department of observation are the richest obtained in any one year since the foundation of the Observatory. One hundred and sixty-one phases were observed, mainly with the 8-inch equatorial. These comprise one hundred and thirty-two disappearances at the dark and eleven at the bright limb, and twelve reappearances at the dark and six at the bright limb. Fifteen *Nautical Almanac* stars were observed in both phases. For the one hundred and sixty-one phases, one hundred and nine stars have been identified, and the places of the remaining fifty-two stars were approximately determined at the time of observation. The complete results have been forwarded to the *Astronomische Nachrichten*. It is very desirable that some meridian observer should at once take up the observation of the fifty-two unidentified stars so that in the future utilization of the observations all doubt as to proper motion may be avoided. During the past thirty-three years eight hundred and fifty-three occultation phases have been observed, and although the year 1895 was the record year in this department, presenting as it did sixty-five observed phases, it has been greatly surpassed by that just elapsed. Mr. Joseph Brooks, F.R.A.S., during the year 1896, again kindly provided the Observatory with predictions of occultations of *Nautical Almanac* stars.

MINOR PLANETS:—The 8-inch equatorial and filar-micrometer have done good service in the observation of minor planets. The following is a statement of the work in this department:—

Planet Observed.	Nights of Observation.	Number of Comparisons.
Hebe (6)	11	162
Flora (8)	9	113
Parthenope (11)	18	196
Calliope (22)	8	84
Danaë (61)	7	75
Sappho (80)	3	34
Undina (92)	4	55
Siwa (140)	10	91
Totals...	70	810

Hebe and *Parthenope* were observed at the request of Dr. R. Luther, of Düsseldorf, and *Calliope* and *Siwa* at that of Dr. J. Bauschinger, of Berlin, both of whom kindly provided the Observatory with manuscript ephemerides.

COMETS :—There has been no comet sufficiently bright to be observed with the 8-inch telescope. Notice of the discovery of Comet *Perrine* of December 8 was received on December 11, but cloudy weather prevailed till the 15th, when a search was made in the bright moonlight, but without success. A search was again made during the absence of the moon on the 22nd, but this was also unsuccessful. While on this subject it will be necessary to correct a statement in the last Report respecting the bright comet discovered by Perrine on November 16, 1895. It appears that the elements and an ephemeris of that comet were cabled from Kiel to Melbourne on December 8, but from inquiries subsequently made it also appears that the cable message did not reach the Melbourne Observatory.

PHENOMENA OF JUPITER'S SATELLITES :—These were closely watched and recorded during the first five months of the year. The phenomena observed are classified thus :—Transit-ingress, I. 5, II. 1, III. 1 ; Transit-egress, I. 4, II. 2, III. 1 ; Occultation disappearances, I. 7, II. 2, III. 2 ; Occultation-reappearances, III. 2 ; Eclipse disappearances, II. 1, III. 2, IV. 1 ; Eclipse reappearances, I. 8, II. 2, III. 1, IV. 1. These observations have since appeared in the *Monthly Notices* of the Royal Astronomical Society. During the same period two remarkable dark spots were observed on the disk of the primary. Nine transits of one spot and seventeen of the other were observed across the central meridian of the planet. Ephemerides of the spots were likewise circulated from the Observatory in the hope that they might be independently observed elsewhere. The observations were presented to the New South Wales Branch of the British Astronomical Association.

DOUBLE STARS :—In consequence of the observer's close application to other departments of observation much attention could not be paid to double-star work. Seven evenings were devoted to this work, during which one hundred and ninety-nine settings were made for position angle and one hundred and fifty-three double measures for distance. The following are the

objects measured :—*p Eridani, Lacaille* 2145, *V Puppis, γ Piscis Volantis, γ Centauri, β Muscæ, α Centauri,* and *A Scorpii.*

VARIABLE STARS :—A well-connected series of comparisons of *R Carinæ* and a few comparisons of *T. Centauri* were secured. The first mentioned variable was compared with neighbouring stars on thirty-three evenings and some of the results communicated to the New South Wales Branch of the British Astronomical Association. Its maximum occurred about March 8 with a magnitude of 5·3 of the scale of the *Uranometria Argentina.* At the close of the year it was again approaching its maximum, the magnitude being estimated as 4·9.

Meteorological Observations.

These have been regularly made and the summer of 1895-96 proved to be the hottest experienced at Windsor since observations were commenced in 1863. On January 6, 12, 13, and 18 the highest shade temperatures were respectively 116·5, 116·6, 118·4, and 115·9 degrees. Many deaths occurred in the Colony from heat apoplexy. The excessively hot summer may be regarded as nature's compensation for the extraordinarily cold winter of 1895.

Publications.

The following papers have appeared in various scientific journals since the publication of the last Report :—

OBSERVATIONS OF THE VARIABLE STAR R CARINÆ FROM 1890 DECEMBER TO 1895 AUGUST.—*Royal Astronomical Society's Monthly Notices,* vol. lvi., p. 351.

RESULTS OF DOUBLE STAR MEASURES WITH THE 8-INCH EQUATORIAL IN 1895.—*R.A.S. Monthly Notices,* vol. lvi., p. 353.

OBSERVATIONS OF PHENOMENA OF JUPITER'S SATELLITES IN 1896.—*R.A.S. Monthly Notices,* vol. lvii., p. 26.

STAR OCCULTATIONS OBSERVED IN 1895.—*Astronomische Nachrichten,* Band cxl., p. 345.

OBSERVATIONS OF MINOR PLANETS HEBE AND PARTHENOPE IN 1896.—*Ast. Nach.,* Band cxlii., p. 103.

DAYLIGHT OCCULTATION OF B.A.C. 6127, 1895, AUGUST 29.—*Journal of the British Astronomical Association,* vol. vi., p. 219.

. OBSERVATIONS OF DARK SPOTS ON THE PLANET JUPITER 1896 JANUARY TO MAY.—*Journal of the B.A. Association,* vol. vii., p. 59.

OBSERVATIONS OF MINOR PLANETS IN 1896, R.A.S.—*Monthly Notices*, vol. lvii., p. 74. (Corrections of several important misprints in this communication have been forwarded to the Society for publication.)

The Library.

Fifty-three scientific institutions and twenty individuals have contributed to the library during the year, to whom the proprietor tenders his best thanks. A list of the donations is appended to the Report.

Personal Establishment.

All the astronomical and nearly all the meteorological observations have been made by the proprietor. During a day's absence from home about once in three weeks the latter observations were made by his son. In some of the reductions of the astronomical and meteorological observations the services of Mr. R. B. Walker have been engaged. His accuracy as a computer is highly satisfactory.

Observations recently utilized.

The local observations of the Great Comet 1881, III., published in *Ast. Nach.,* Band c., p. 333, and in *R.A.S. Monthly Notices,* vol. xli., p. 442, find a place in a definitive determination of the orbit by Dr. J. Riem, entitled "*Ueber die Bahn des grossen Kometen,* 1881, III. (*Tebbutt*)." The positions, eleven in number, except June 4th and 11th, were employed. The observation June 11th, although representing the place of the comet within 19″, is not a ring-micrometer one as misunderstood by the author. It was simply the result of *circle* comparisons with *Rigel* in the morning twilight.

The observations of Holmes' Comet 1892 III., with the 4½-inch equatorial, published in *Ast. Nach.,* Band cxxxii., p. 25, have been discussed, with numerous observations made in the northern hemisphere. See *Bestimmung der Bahn des Cometen* 1892 III. (*Holmes*), *von Ernst Kohlschütter, Dr. Phil.,* 1896. The Windsor observations, the only positions obtained in the

southern hemisphere, were made under the worst possible conditions and it was with much diffidence that they were sent to Europe for publication. They received but small weight in the discussion.

Dr. Auwers, in his discussion in 1884 of the local occultation observations in 1873-6 for longitude, referred to an earlier series of observations at the same place for the period 1864-70, which he had not then an opportunity of taking into account. These observations were made with the old 3½-inch refractor, the stars not being identified, but the places of disappearance on the moon's dark limb being estimated in position angle from the moon's north cusp. The discussion of this early series of observations has just been completed by Dr. Hugo Clemens, of Göttingen, in his Inaugural Dissertation *Bestimmung der Länge von Windsor, N.S. Wales (Tebbutt's Sternwarte) aus Sternbedeckungen* 1864 *bis* 1870, and with a very satisfactory result. Of the seventy-eight occultation-phases observed, sixty-six have been employed for the determination of the longitude, which comes out 10h. 3m. 20·60s. E. of Greenwich. Of the remaining twelve observations five, namely Nos. 22, 35, 36, 58 and 73, could not be made within several seconds of time, as will be seen from the observer's remarks, and are therefore omitted. In two cases, Nos. 61 and 70, no accurate position of the occulted star was available, and in two, Nos. 53 and 72, the geometrical conditions were unsatisfactory. In two cases, Nos. 34 and 50, there seems to be some probability of a small error in the observed time, and the remaining case, No. 74, is rejected with the remark, "Fehler in der Zeitnotierung?" Considering, however, the very careful way in which the observed times were noted and verified, I was curious to examine this observation. I soon identified the occulted star, 6½ magnitude, as Arg-Oeltzen 17374=Brussels 7243=Arg. Gen. Cat. 24345=Cincinnati Zones 1885, 2907. Adopting its mean position for 1870·0 and its apparent position for October 28 as R.A.=17h. 48m. 31·81s. (32·60s.), Declin=-21° 55′ 51·9″ (49·8″), the lunar elements from the *Nautical Almanac*, the values of α and δ being corrected by the application of Newcomb's quantities for October 28, 1870, on page 29 of Dr. Clemens' work, I find that at my noted time, Oct. 28d. 8h. 46m. 58·8s., the star was actually only 1·4″ within the moon's dark limb at a

point 142° from the north cusp, the estimated angle being 135°. The observation, if properly reduced, would no doubt have given a satisfactory value for the longitude, and should not therefore have been rejected. Moreover the reductions of the star to apparent right ascension and declination in Dr. Clemens' work are greatly in error, +0·555s.+14·78″ should be +0·79s. +2·08″ respectively. This error alone would entail a large error in the deduced longitude. Finally, it is quite possible that the unsatisfactoriness of the results from observations Nos. 34 and 50 may be explained in some other way than by the assumption of an error in the noted times. Altogether it is exceedingly gratifying to find that the series of occultations 1864-70 has given such a satisfactory result and the gratitude of astronomers generally is due to Dr. Clemens for this additional attempt to determine a fundamental meridian for Australia.

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[Note.—The names of the donors are printed in italics.]

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A Chart of Circumpolar Stars, by same; pp. 3, with plate.

The Meteor of June 27, 1894, by same; pp. 3.

A Map showing the Average Monthly Rainfall in New South Wales, by same; pp. 3, with map.

Design for a Photographic Transit Circle, by same; pp. 5, with plate.

Recent Measures of Double Stars at Sydney, by same; pp. 4.

The Government Observatory, Sydney.

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On the Occurrence in Stellar Spectra of the Lines of Cleveite Gas, and on the Classification of Stars of the First Spectral Type, by H. C. Vogel; pp. 14. *The Author.*

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Zusammenstellung der Cometen-Erscheinungen des Jahres 1895, von H. Kreutz; pp. 7. *The Author.*

Die Sucherkreise parallaktisch montirter Fernrohre, von Dr. O. Knopf in Jena; pp. 4, with diagrams.

Jena (Universitäts Sternwarte) Jahrgang 29, Heft. 2; pp. 2; and Jahrgang 30, Heft. 3; pp. 2, von O. Knopf. *The Author.*

On the Periodic Changes of the Variable Star Z *Herculis*, by N. C. Dunér; pp. 10. *The Author*

La Cornoide, Alberto Sanchez; pp. 71. *The Author*

Rubra Canicula. Giovanni Schiaparelli p.p. 37. *The Author.*

ERRATA.

In the Report for 1895—

Page 23, line 17 from top, remove the Comma.

Page 24, line 22 from top, *for* La *read* Le.

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HUNTER STREET.

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1897.

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association; Corresponding Member of the Société Ethnographique of Paris, and Honorary Corresponding Member of the Queensland Branch of the Royal Geographical Society of Australasia.

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CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY

For 1897.

THE observing weather during the year 1897 was very favourable, and I am therefore enabled to present a good report.

Buildings and Instruments.

These remain the same as they were at the close of 1894. During the year some few repairs were made, and a considerable amount of painting was done.

Position of the Observatory.

No further attempt has been made to determine the co-ordinates of the Observatory. They are, therefore, still adopted as:—Longitude from Greenwich=10h. 3m. 20·5s. E. Astronomical latitude= −33° 36′ 30·8″. A summary of the different values obtained for the longitude is given in the last Report.

Meridian Work.

Sidereal 8-day chronometer, *John Poole,* No. 2962, was still employed as the timekeeper, and was regulated during the year by means of the Cooke and Sons' 3-inch transit instrument. The method adopted for the reduction of the transit observations is fully explained in the Report for 1890. The equatorial values of the outer wires of the transit system in sidereal time were adopted throughout as—

A=+20·191s., B=+10·502s., D=−9·319s., E=−19·014s., with a reduction of +0·472s. to the middle wire for complete transits of an equatorial star. These values were derived from

a discussion of all the transits of circumpolar stars from January 27 to December 31, 1896. The reductions of the transits of circumpolar stars during 1897 for equatorial values of the wires were made to keep pace with the transit observations themselves, but no change was detected in the distances of the wires. The following are the values resulting from the transits of 1897 :—

A=+20·198s., B=+10·432s., D=−9·334s., E=−19·018s. with a reduction of +0·456s. to the middle wire.

The inclination of the rotation axis of the transit instrument has been subject to great and sudden changes during the year, and the adjustments were large and frequent, as will be seen from an inspection of the usual table of Instrumental Errors. Some of the changes have doubtless been due to the saturation of the soil by heavy rains. The azimuth error has also on some occasions been greatly affected. The following is a summary of the meridian work during the year :—

Nights on which the local time was determined ...	...	168
Stars observed with a declination not exceeding 40°	...	921
Stars of high declination observed for azimuth ...	...	244
Separate determinations of { level error... ...	...	508
Separate determinations of { collimation error ..	...	45
Separate determinations of { azimuth error ...	...	182

The usual table here follows, showing the errors of the transit instrument and the errors and rates of the chronometer, *John Poole,* which was also always employed in the extra-meridian department. The apparent right ascensions of both clock and azimuth stars have again been taken from the *American Ephemeris.*

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
1896.										
Dec. 31	6	W.E.	− 1.4	+ 2.6	+ 1.06 + 4.37	δ Hydri, σ Arietis, E. μ Hydri, ε Arietis, E.	2 46	21 4.35		
1897.										
Jan. 6	3	E.	+ 13.6	[+ 2.5]	+ 1.84	ξ² Ceti, μ Hydri	2 57	21 24.33	0·139	
„ 11	9	E.W.	− 15.7	+ 2.4	− 2.36 − 1.95 − 0.55	α Arietis, δ Hydri E. Algol, ι Hydri, E. γ Tauri, δ Mensæ, W.	4 9	21 44.91	0.171	0.21
„ 12	4	W.	− 15.7	[+ 2.4]	− 1.95	Algol, ι Hydri	3 8	21 49.78	0.212	0.20
„ 14	8	W.	− 16.0	[+ 2.3]	[− 1.8]		5 30	21 58.43	0.172	0.15
„ 15	4	W.	− 16.1	[+ 2.2]	− 1.65	Algol, ι Hydri	3 16	22 1.43	0.138	0.15
„ 20	9	W.E.	− 11.4	+ 2.0	− 0.78	δ Mensæ, α Tauri	5 53	22 23.67	0.181	0.19
„ 21	4	E.	− 8.0	[+ 2.0]	− 4.24	ε Geminorum, ζ Mensæ	7 4	22 28.50	0.192	0.18
„ 24	8	E.	− 5.8	[+ 2.0]	− 4.80	γ Hydri, A Tauri	4 0	22 39.68	0.162	0.16
Feb. 7	6	W.E.	− 8.7	+ 2.0	− 2.78	γ Hydri, γ Tauri, W.	4 56	23 32.83	0.158	0.19
„ 13	8	E.	− 5.4	[+ 2.5]	− 5.23 − 4.56	θ Chamæleontis, γ Cancri κ Cancri, β Argûs	8 45	24 2.16	0.198	0.19
„ 14	6	E.W.	− 4.5	+ 2.6	[− 5.9]		5 43	24 5.99	0.183	0.20
„ 15	4	W.	− 3.4	[+ 2.6]	− 6.96	ι Aurigæ ζ Mensæ	5 3	24 10.84	0.208	0.20
„ 17	5	W.	− 2.3	[+ 2.7]	− 5.66	π Mensæ, η Geminorum	5 28	24 ·19.83	0.186	0.18
„ 21	4	W.	− 3.0	[+ 2.7]	− 6.48 − 1.53	ζ Mensæ, β Canis Min. γ² Piscis Vol. β Canis Min	7 33	24 36.40	0.169	0.17
„ 22	5	W.	− 2.1	[+ 2.8]	− 7.00	β Cancri, θ Chamæleontis	8 20	24 40.61	0.170	0.18
„ 23	3	W.	− 1.6	[+ 2.8]	[− 7.1]		8 15	24 44.99	0.183	0.18
„ 24	4	W.E.	− 1.0	+ 2.8	− 7.19	δ Doradûs, θ Aurigæ, E.	5 54	24 48.72	0.172	0.21
„ 25	3	E.	− 2.7	[+ 2·7]	− 5.58	π Mensæ, β Aurigæ	6 8	24 54.55	0.241	0.25

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast or Slow on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
1897										
Feb. 28	4	E.	− 4.5	[+ 2.7]	− 7.50	δ Doradûs, β Aurigæ	5 36	25 . 0.43	0.251	0.24
March 3	2	E.	− 5.4	[+ 2.5]	[− 9.1]		5 59	25 24.15	0.197	0.16
„ 4	6	E.W.	− 5.5	+ 2.4	− 9.45	δ Doradûs, β Aurigæ, E.	6 25	25 27.97	0.156	0.15
„ 5	4	W.	− 5.4	[+ 2.5]	− 7.44	δ Doradûs, β Aurigæ	6 20	25 31.48	0.147	0.20
„ 6	3	W.	− 4.1	[+ 2.5]	[− 8.4]		16 11	25 39.16	0.227	0.21
„ 7	4	W.	− 6.2	[+ 2.6]	− 9.40	δ Doradûs, β Aurigæ	6 26	25 41.95	0.196	
„ 7	5	W.	− 5.7	[+ 2.6]	− 12.87	γ Apodis, β Herculis	10 55	324 36.80		
„ 8	3	W.	− 6.5	[+ 2.6]	[− 10.4]		0 36	324 33.55	0.238	0.25
„ 9	8	W.	− 5.7	[+ 2.7]	− 7.83 − 8.06	δ Doradûs, β Aurigæ ψ^5 Aurigæ, ζ Mensæ	1 8	324 26.53	0.287	0.30
„ 10	5	W.	− 5.3	[+ 2.7]	− 10.42	α Tri. Aust., *d* Herculis	11 22	324 16.00	0.308	0.30
„ 11	6	W.E.	− 7.5	+ 2.8	− 10.24	δ Doradûs, β Aurigæ, W.	1 9	324 12.45	0.301	0.28
„ 12	4	E.	− 8.0	[+ 2.8]	− 8.84	δ Doradûs, β Aurigæ	0 40	324 6.68	0.245	0.22
„ 13	5	E.	− 9.1	[+ 2.8]	− 9.06	ε Geminorum. ζ Mensæ	1 0	324 1.84	0.199	0.18
„ 14	5	E.	− 8.5	[+ 2.8]	− 7.88	ψ^5 Aurigæ, ζ Mensæ	1 17	323 57.70	0.170	0.19
„ 15	5	E.	− 8.6	[+ 2.8]	− 8.57	ψ^5 Aurigæ. ζ Mensæ	0 46	323 52.84	0.207	0.20
„ 15	2	E.	− 7.7	[+ 2.8]	[− 8.4]		11 54	323 50.54	0.207	
„ 20	8	E.W.	− 12.7	+ 2.8	− 6.97	γ^2 Pis. Vol., β Canis Min. E.	7 7	0 0.49		
„ 26	5	W.E.	− 10.3	+ 1.6	[− 7.6]		7 40	0 31.27	0.218	0.19
„ 27	5	E.	− 10.5	[+ 1.7]	− 7.68	γ^2 Piscis Vol., α^2 Gemin.	7 41	0 35.85	0.191	0.19
„ 28	5	E.	− 10.3	[+ 1.8]	− 10.53	ζ Mensæ, ζ Geminorum	6 51	0 39.99	0.179	0.18
„ 29	4	E.	− 10.1	[+ 1.9]	− 10.05	ε Geminorum, ζ Mensæ	6 24	0 44.24	0.180	0.17
„ 30	7	E.W.	− 9.9	+ 2.0	− 9.67	ε Geminorum, ζ Mensæ E.	6 57	0 48.04	0.155	0.16
„ 31	4	W.	− 9.5	[+ 1.9]	− 6.27	ε Geminorum. ζ Mensæ	6 33	0 51.82	0.160	0.16
April 1	4	W.	− 9.4	[+ 1.9]	− 6.54	ε Geminorum, ζ Mensæ	6 33	0 55.52	0.154	0.14
„ 2	4	W.	− 9.3	[+ 1.8]	− 6.82	ε Geminorum, ζ Mensæ	6 48	0 58.78	0.138	0.14

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1897.			"	"	"		H. M.	M S.	S.	S.
April 5	7	W.E.	− 8.8	+ 1.6	− 5.53	θ Chamæl., γ Cancri, E.	7 35	1 9.77	0.152	0.16
„ 6	5	E.	− 8.8	[+ 1.8]	− 7.16	β Cancri, θ Chamæleontis	8 2	1 13.83	0.166	0.16
„ 7	5	E.	− 9.6	[+ 2.0]	− 7.71	ζ Geminor. γ² Piscis Vol.	6 54	1 17.46	0.159	0.15
„ 8	8	E.	− 10.3	[+ 2.2]	− 9.28 − 8.93	ζ Chamæl., 19 Leo. Min. 41 Leo. Min., δ² Chamæl.	10 20	1 21.58	0.150	0.17
„ 9	2	E.	− 9.3	[+ 2.4]	[− 9.0]		7 1	1 25.59	0.194	0.18
„ 10	10	E.W.	− 9.8	+ 2.6	− 6.40 − 11.41	κ Cancri, β Argûs, E. ζ Cham., 19 Leo. Min., W	9 26	1 29.80	0.159	0.17
„ 13	5	W.	− 8.1	[+ 2.6]	− 8.31	γ² Piscis Vol., β Canis Min.	9 9	1 44.64	0.207	0.25
„ 14	5	W.	− 7.4	[+ 2.6]	− 9.56	θ Chamæleontis, γ Cancri	8 20	1 50.82	0.267	0.26
„ 16	4	W.	− 7.6	[+ 2.6]	− 8.24	θ Chamæleontis, γ Cancri	8 30	2 2.83	0.249	0.23
„ 17	5	W.E.	− 7.2	+ 2.6	− 9.69 − 9.25	ι Ursæ Maj., β Argûs, W. ζ Cham., 19 Leo. Min., E.	8 6	2 8.07	0.220	0.21
„ 18	4	E.	− 6.1	[+ 2.4]	− 10.30	ζ Chamæl., 19 Leonis Min.	7 39	2 12.68	0.196	0.20
„ 19	7	E.	− 5.1	[+ 2.2]	− 10.98	η Octantis, ν Ursæ Major.	9 5	2 17.74	0.199	0.23
„ 19	8	E.	− 3.9	[+ 2.2]	[− 11.0]		20 18	2 20.40	0.237	0.26
„ 20	8	E.	− 4.1	[+ 2.0]	[− 11.2]		7 7	2 23.35	0.273	0.27
„ 24	8	E.W.	− 4.2	+ 1.2	− 11.95	θ Ursæ Maj., ζ Cham., W.	8 49	2 47.40	0.246	0.21
„ 26	4	W.	− 3.8	[+ 1.5]	[− 11.2]		7 15	2 56.44	0.195	0.18
„ 27	6	W.E.	− 2.7	+ 1.6	− 9.37 − 12.25	λ Urs. M., β Octa. S.P., W. η Octan., ν Ursæ Maj. E.,	10 51	3 1.17	0.171	0.18
„ 29	5	E.	− 2.3	[+ 1.9]	− 12.02 − 10.91	θ Ursæ Maj., ζ Chamæl. ρ Leonis, β Octantis S.P.	9 58	3 10.39	0.196	0.20
May 2	3	E.	− 2.9	[+ 2.4]	− 7.76	ρ Leonis, β Octantis S.P.	11 23	3 24.88	0.197	0.18
„ 3	4	E.	− 2.7	[+ 2.5]	− 8.24	θ Chamæleontis, γ Cancri	8 37	3 28.55	0.173	0.18
„ 4	5	E.	− 2.4	[+ 2.6]	− 7.76	β Cancri, θ Chamæleontis	7 49	3 32.99	0.191	0.18

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1897.			"	"	"		H. M.	M. S.	S.	S.
May 5	5	E.W.	− 2.6	+ 2 8	− 7.44	β Cancri, θ Chamæl., E.	8 58	3 37.15	0.165	0.19
„ 6	3	W.	− 2.8	[+ 2.7]	[− 9.4]		7 35	3 41.89	0.210	0.22
„ 8	8	W.	− 2.6	[+ 2.5]	− 13 26	η Octantis, δ Leonis	10 20	3 53.97	0.238	0.25
„ 9	8	W.	− 3.1	[+ 2.3]	− 11.51	46 Leonis Min., η Octantis	9 33	4 0.08	0.263	0.26
„ 10	2	W.	− 3.5	[+ 2.2]	− 10.78	θ Ursæ Maj., ζ Chamæl.	9 59	4 6.59	0.266	0.25
„ 11	5	W.	− 3.6	[+ 2.1]	− 8.10	ρ Leonis, β Octantis, S.P.	10 15	4 12.47	0.242	0.22
„ 12	7	W.E.	− 4.2	+ 2.0	− 7.89	β Oct., S.P., 46 Leo. Min. E.	10 20	4 17.46	0.207	0.20
„ 13	4	E.	− 3.7	[+ 2.0]	− 6.92	β Oct., S.P., 46 Leo. Min.	10 39	4 22.05	0.189	0.19
„ 15	5	E.	− 5.1	[+ 2.0]	− 9.83	46 Leonis Min, η Octantis	10 27	4 31.66	0.201	0.19
„ 16	2	E.	− 4.5	[+ 2.0]	[− 8.6]		9 10	4 35.88	0.186	0.21
„ 17	4	E.	− 4.8	[+ 2.0]	− 7.37	ρ Leonis, β Octantis, S.P.	9 25	4 41.38	0.227	0.22
„ 18	4	E.	− 4.5	[+ 2.0]	− 7 47	ρ Leonis, β Octantis, S.P.	9 25	4 46.60	0.218	0.24
„ 19	1	E.	− 4.9	[+ 2.0]	[− 8.4]		8 46	4 52.55	0.255	0.25
„ 22	4	E.W.	− 6.3	+ 2.0	− 12.36 − 10.16	31 Comæ Ber., δ Mus., E. κ Oct., η Ursæ Maj., W.	13 17	5 10.88	0.240	0.22
„ 26	4	W.	− 6.8	[+ 2.2]	− 8.39	β Chamæleontis, β Hydri	12 13	5 29.66	0.198	0.20
„ 27	4	W.	− 7.4	[+ 2 2]	[− 8.7]		11 29	5 34 32	0.200	0.20
June 2	6	W.E.	+ 71.7 + 0.7	+ 2.4	− 10.54	β Chamæleontis, β Hydri	11 50	6 0.57	0.182	0.17
„ 8	4	E.	+ 26.1 − 0.9	[+ 1.7]	− 8.49	β Chamæleontis, β Hydri	12 2	6 22.76	0.154	0.12
„ 9	7	E.W.	− 0.8	+ 1.6	− 8.88	κ Octantis, η Ursæ Maj., E.	13 55	6 25.84	0.119	0.12
„ 10	5	W.	+ 2.0	[+ 1.5]	− 5.39	o Virginis, β Chamæleontis	11 46	6 28.33	0.114	
„ 13	4	W.	+ 1.4	[+ 1.3]	− 3.73	β Chamæl., 31 Comæ Ber.	12 37	2 44.90		
„ 14	8	W.E.	+ 1.0	+ 1.2	− 4.85	ρ Octantis, α Cor. Bor., W.	14 30	2 47.55	0.102	0.10
„ 19	2	E.	− 0.4	[+ 1.7]	− 6.37	θ Virginis, κ Octantis	13 15	2 58.90	0.096	0.08

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1897.			″	″	″		H. M.	M. S.	S.	S.
June 20	7	E.W.	− 0.6	+ 1.8	− 5.40 − 8.62	ρ Leonis, β Octa., S.P., E. β Chamæl., β Hydri, W	11 26	3 0.58	0.076	0.08
„ 21	6	W.	+ 1.2	[+ 1.9]	− 4.44	β Chamæleontis, β Hydri	10 56	3 2.94	0.104	0.10
„ 23	5	W.	− 0.3	[+ 2.1]	− 7.60	κ Octantis, η Bootis	13 25	3 8.05	0.101	0.09
„ 26	4	W.	− 0.3	[+ 2.4]	− 4.66	β Chamæleontis, β Hydri	11 51	3 18.88	0.088	0.11
„ 27	4	W.	− 1.1	[+ 2.5]	− 9.93 − 4.42	δ Muscæ, ζ Virginis η Bootis, θ Apodis	13 37	3 16.85	0.115	0.11
„ 28	7	W.E.	− 1.6	+ 2.6	− 3.19	β Chamæl., β Hydri, W.	12 10	3 19.35	0.111	0.12
„ 29	4	E.	− 2.1	[+ 2.5]	− 3.49	β Chamæleontis, β Hydri	10 43	3 22.29	0.130	0.12
„ 30	4	E.	− 2.6	[+ 2.5]	− 3.54	β Chamæleontis, β Hydri	12 16	3 24.94	0.104	0.11
July 2	5	E.	− 4.1	[+ 2.3]	− 5.62	κ Octantis, B.A.C. 4536	13 3	3 30.23	0.108	0.11
„ 4	6	E.W.	− 4.3	+ 2.2	− 5.72	κ Octantis, η Ursæ Maj. W.	12 55	3 36.03	0.121	0.13
„ 5	10	W.	− 4.0	[+ 2.3]	− 6.96 − 5.50	κ Octantis, η Ursæ Maj. μ Hydri, S.P., ε Bootis	13 44	3 39.18	0.127	0.13
„ 6	7	W.	− 6.5	[+ 2.3]	− 3.51	β Chamæleontis, β Hydri	14 56	3 42.68	0.139	0.16
„ 7	10	W.	− 5.7	[+ 2.3]	− 3.43 − 4.60	β Chamæl., β Hydri η Ursæ Maj., θ Apodis	13 16	3 46.71	0.180	0.18
„ 8	10	W.E.	− 7.3	+ 2.4	− 4.19 − 2.86 − 5.95	δ Octantis, θ Bootis, W. ρ Octantis, α Cor. Bor. W. γ Apodis, β Herculis, E.	16 10	3 51.28	0.170	0.15
„ 9	8	E.	− 6.9	[+ 2.5]	− 2.48 − 3.75	β Chamæl., β Hydri η Ursæ Maj., θ Apodis	14 7	3 54.08	0.128	0.13
„ 10	8	E.	− 8.3	[+ 2.6]	− 3.58	ρ Octantis, α Coronæ Bor.	14 7	3 57.04	0.123	0.15
„ 11	8	E.	− 8.1	[+ 2.7]	− 3.67 − 2.15	β Chamæl., 31 Com. Ber. ρ Octantis, α Cor. Bor.	14 42	4 1.25	0.171	0.17
„ 14	6	E.W.	− 11.2	+ 3.0	− 6.16	η Bootis, θ Apodis, E.	14 59	4 13.01	0.163	0.16

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1897.			"	"	"		H. M.	M. S.	S.	S.
July, 20	6	W.E.	− 14.8	+ 2.4	− 3.98	δ Octantis, θ Bootis, W.	15 16	4 34.70	0.150	0.14
Aug. 1		E.	− 349.9							
„ 2	9	E.W.	+ 10.1	+ 2.0	+ 15.55 + 16.62	α Cor. Bor., δ^1 Apodis, E. b Ophiuchi, β Drac., W.	16 36	5 8.31	0.107	0.14
„ 3	8	W.	+ 10.2	[+ 1.9]	+ 17.24 + 18.75	b Ophiuchi, β Draconis γ Draconis, γ^2 Sagittarii	17 37	5 11.94	0.145	0.14
„ 4	8	W.	+ 11.5	[+ 1.9]	+ 16.21	b Ophiuchi, β Draconis	16 17	5 15.09	0.139	0.14
„ 11	8	W.E.	+ 17.3 − 5.0	+ 1.4	+ 17.85	γ Apodis, β Herculis, W.	15 43	5 34.11	0.114	0.11
„ 15	5	E.	− 2.0	[+ 2.3]	+ 20.02	γ Draconis, γ^2 Sagittarii	16 7	5 44.61	0.109	0.11
„ 16	4	E.	− 0.5	[+ 2.6]	+ 17.70	ε Bootis, α Tri. Aust.	14 48	5 47.18	0.113	0.13
„ 17	8	E.W.	− 0.6	+ 2.8	+ 17.18	α Tri. Aust., d Herculis, E.	16 31	5 51.01	0.149	0.16
„ 18	5	W.	− 0.2	[+ 2.7]	+ 17.70	δ^1 Apodis, τ Herculis	15 2	5 55.00	0.177	0.18
„ 19	4	W.	+ 1.0	[+ 2.7]	+ 17.58	δ^1 Apodis, τ Herculis	14 45	5 59.19	0.177	0.17
„ 23	5	W.	+ 3.7	[+ 2.5]	+ 16.72	σ Octantis	18 12	6 12.66	0.135	0.13
„ 25	6	W.E.	+ 4.7	+ 2.4	+ 19.10	b Ophiuchi, β Draconis, W.	17 53	6 18.59	0.124	0.13
„ 26	4	E.	+ 7.0	[+ 2.3]	+ 18.06	δ^1 Apodis, τ Herculis	15 50	6 21.45	0.130	0.13
„ 27	5	E.	+ 8.5	[+ 2.2]	[+ 19.5]		15 52	6 24.40	0.123	0.12
„ 29	7	E.	+ 10.1	[+ 2.0]	+ 22.40 + 20.60 + 19.29	b Ophiuchi, β Draconis γ Draconis, γ^2 Sagittarii σ Octantis	17 56	6 30.57	0.123	0.16
„ 30	6	E.	+ 12.2	[+ 2.0]	+ 21.19	γ Draconis, γ^2 Sagittarii	18 8	6 34.70	0.172	0.17
„ 31	4	E.	+ 14.2	[+ 1.9]	+ 17.22	γ Apodis, β Herculis	16 14	6 38.44	0.169	0.20
Sept. 1	10	E.W.	+ 13.4	+ 1.8	+ 18.19 + 22.68	γ Apodis, β Herculis, E. σ Octantis, W.	17 51	6 44.53	0.238	0.23

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1897.			″	″	″		H. M.	M. S.	S.	S.
Sept. 2	7	W.	+ 15·3	[+ 1.9]	+ 19.49 + 20.97	γ Apodis, β Herculis σ Octantis	18 0	6 50.07	0.229	0.20
„ 3	6	W.	+ 16.5 – 11.3	[+ 2.0]	+ 22.92	b Ophiuchi, β Draconis	16 42	6 54.09	0.177	0.18
„ 4	10	W.	– 10.3	[+ 2.2]	+ 18.69 + 23.39	γ Apodis, β Herculis υ Octantis, α Lacertæ	18 27	6 58.81	0.183	0.17
„ 5	6	W.	– 7.5	[+ 2.3]	+ 21.14	σ Octantis	16 21	7 2.28	0.158	0.16
„ 6	10	W.E.	– 6.9	+ 2.4	+ 21.35	σ Octantis, W.	18 9	7 6.55	0.166	0.16
„ 7	6	E.	– 6.6	[+ 2.5]	+ 23.84	Altair, ε Pavonis	20 5	7 10.53	0.153	0.15
„ 9	2	E.	– 1.9	[+ 2.6]	[+ 22.7]		17 15	7 17.60	0.157	0.17
„ 10	3	E.	– 0.6	[+ 2.6]	+ 22.07	α Tri. Aust., κ Ophiuchi	16 43	7 21.63	0.172	0.17
„ 11	4	E.	+ 0.5	[+ 2.7]	+ 21.28	α Tri. Aust., κ Ophiuchi	16 29	7 25.45	0.161	0.16
„ 13	5	E.	+ 3.4	[+ 2.7]	+ 22.13	α Tri. Aust., κ Ophiuchi	16 56	7 33.56	0.167	0.16
„ 14	7	E.W.	+ 3.3	+ 2.8	+ 23.95 + 23.15	ζ Pavonis, β Lyræ, E. σ Octantis, E.	18 28	7 37.63	0.159	0.16
„ 17	5	W.	+ 6.4	[+ 3.0]	+ 22.12	σ Octantis	17 37	7 48.49	0.153	0.15
„ 18	5	W.	+ 7.3	[+ 3.0]	+ 23.37	σ Octantis	18 4	7 52.06	0.146	0.18
„ 19	5	W.	+ 8.3	[+ 3.1]	+ 21.57	σ Octantis	16 55	7 56.71	0.204	0.21
„ 20	4	W.	+ 9.2	[+ 3.1]	[+ 21.7]		18 6	8 2.31	0.222	0.21
„ 25	6	W.E.	+ 10.9	+ 3.4	+ 22.59	σ Octantis, W.	18 49	8 23.32	0.174	0.18
„ 26	5	E.	+ 11.9	[+ 3.2]	+ 23.37 + 26.15	σ Octantis δ Cygni. ε Pavonis	17 8	8 27.49	0.187	0.19
„ 27	2	E.	+ 12.1	[+ 3.1]	[+ 25.4]		21 58	8 33.19	0.198	0.20
„ 29	6	E.	+ 12.7	[+ 2.7]	+ 26.66	λ¹ Octantis, 16 Pegasi	21 29	8 42.24	0.190	0.20
„ 30	7	E.	+ 13.0	[+ 2.6]	+ 24.24	π Pegasi, υ Octantis	22 12	8 47.27	0.203	0.20

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
1897. Oct. 1	8	E.W.	+ 12.9	+ 2.4	+ 21.47	σ Octantis, E.	19 40	8 51.66	0.204	0.22
„ 8	9	W.	+ 12.0	[+ 2.2]	+ 26.93 + 27 03	λ¹ Octantis, π² Cygni π² Pegasi, υ Octantis	20 36	9 3.93	0.251	0.25
„ 5	5	W.	+ 12.0	[+ 2.1]	+ 26.57	ι Pegasi, λ¹ Octantis	19 51	9 15.85	0.252	0.23
„ 6	9	W.E.	+ 11.6	+ 2.0	+ 25.57	λ¹ Octantis, π² Cygni, W.	21 7	9 21.39	0.219	0.23
„ 7	5	E.	+ 11.3 + 13.5	[+ 2.0]	+ 19.80 + 22.57 + 0.19	α Pavonis, ε Delphini β Pavonis, ε Cygni λ¹ Octantis, π² Cygni	21 6	9 27·19	0.242	0.24
„ 8	7	E.	+ 13.7	[+ 2.1]	+ 0.49	λ¹ Octantis, π² Cygni	20 38	9 32.61	0.230	0.23
„ 11	5	E.	+ 12.5	[+ 2.2]	— 2.70	π² Pegasi, υ Octantis	21 37	9 50.13	0.240	0.25
„ 12	6	E.W.	+ 12.3	+ 2.2	+ 1 12	λ¹ Octantis, π² Cygni, W.	21 44	9 56.08	0.247	0.24
„ 15	7	W.E.	+ 9.0	+ 3.6	— 0.74	λ¹ Octantis, π² Cygni, W.	21 50	10 10.85	0.205	0.19
„ 16	4	E.	+ 12.2	[+ 3.1]	— 0.83	λ¹ Octantis, π² Cygni	20 56	10 15.00	0.180	0.18
„ 17	6	E.W.	+ 11.5	+ 2.6	— 1.52	β Aquarii, λ¹ Octantis, W.	20 46	10 19.06	0.170	0.17
Nov. 28	7	W.E.	— 6.9	+ 2.0	— 17.48	ι Piscium, γ¹ Octantis, W.	0 47	13 50.73	0.209	0.22
„ 29	7	E.	+ 0.3	[+ 2.1]	— 19.82	λ Andromedæ, γ¹ Octantis	0 47	13 56.08	0.223	0.22
„ 30	7	E.	+ 6.2	[+ 2.2]	— 19.18	λ Andromedæ, γ¹ Octantis	0 57	14 1.48	0.224	0.23
Dec. 1	5	E.	+ 12.1	[+ 2.3]	— 19 77	γ¹ Octantis, α Andromedæ	0 22	14 6.94	0.233	0.20
„ 2	2	E.	+ 16.3	[+ 2.5]	[— 19.7]		0 11	14 11.05	0.173	0.19
„ 5	6	E.W.	+ 0.3	+ 2.8	[— 19.5]		1 36	14 28.22	0.234	0.22
„ 22	8	W.E.	+ 21.7 — 9.7	+ 1.4	— 19.54 — 16.92	β Androm., κ Tucanæ, W. γ Trianguli, μ Hydri, E.	1 52	15 28.30	0.147	0.11
„ 23	6	E.	— 6.9	[+ 1.7]	— 19.92	γ Trianguli, δ Hydri	2 7	15 30.98	0.111	0.13
„ 24	5	E.	— 7.0	[+ 2.0]	— 17.47	μ Hydri, σ Arietis	3 5	15 34.57	0.144	0.13
„ 25	4	E.	— 6.5	[+ 2.5]	— 20.59	β Persei, ι Hydri	3 30	15 37.45	0.118	0.12

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1897.			"	"	"		H. M.	M. S.	S.	S.
Dec. 26	7	E.W.	− 5.3	+ 2.6	{ − 19.48 − 20.35 }	γ Trianguli, δ Hydri, E. β Persei, ι Hydri, W.	2 31	15 40.16	0.118	0.13
„ 27	7	W.	− 3.3	[+ 2.6]	− 17.73	μ Hydri, θ Persei	2 9	15 43.28	0.132	0.13
„ 28	6	W.	− 2.0	[+ 2.6]	− 17.45	μ Hydri, θ Persei	2 47	15 46.26	0.121	0.12
„ 29	8	W.	− 0.9	[+ 2.6]	− 16.71	μ Hydri, σ Arietis	2 55	15 49.22	0.123	0.12
„ 30	3	W.	+ 0.6	[+ 2.6]	− 16.86	η Tauri, γ Hydri	4 7	15 52.04	0.112	0.12
„ 31	7	W.E.	+ 1.0	+ 2.6	{ − 16.83 − 18.61 }	μ Hydri, σ Arietis, W. ι Hydri, δ Persei, E.	3 17	15 54.86	0.122	

NOTES.

January 11th—The eastern pivot was raised 34.4″ before the observations.

March 7th—The chronometer had run down; it was re-started just as I was going to observe Comet Perrine.

March 20th—The chronometer was allowed to run down, and was re-started about noon. A transit could not be observed with clamp west.

June 2nd—Previously to noon the eastern pivot was raised to the extent of 76·2″; the sudden change of level error was probably due to the heavy rain in the night of May 31st. A similar change after heavy rain occurred in June, 1896.

June 8th—The eastern pivot was raised 27.1″ before noon.

June 13th—The chronometer had run down, and was re-started.

August 1st—The eastern pivot was lowered 360.9″ in the afternoon, the level error after the adjustment being + 11·0″; 4.323 inches of rain had fallen in the period of four days.

August 11th—The eastern pivot was raised during the transits with clamp W.

September 3rd—The eastern pivot was raised during the observations.

October 7th—The azimuth was adjusted during the observations, and the level error was somewhat changed by the adjustment.

November 28th—The eastern pivot was raised 60.6″ before the observations.

December 2nd—The eastern pivot was raised 41.5″ after the observations.

December 5th—The eastern pivot was lowered 28.9″ before the observations.

December 22nd—The eastern pivot was raised during the observations.

Extra-Meridian Work.

OCCULTATIONS OF STARS BY THE MOON:—One hundred and thirty-four phases were observed, mainly with the 8-inch equatorial. These comprise 125 disappearances at the dark and three at the bright limb, and two reappearances at the dark and four at the bright limb. The occultations of five *Nautical Almanac* stars were observed in both phases. For 88 phases the stars have been identified, and sufficient data are afforded for the identification of the remaining 46 stars. The complete results have been sent to the *Astronomische Nachrichten*. The number of occultation phases observed at Windsor since the year 1863 now amounts to 987. Mr. Joseph Brooks, F.R.A.S., kindly communicated predictions of occultations of *Nautical Almanac* stars for the first eight months of the year.

PLANET OBSERVATIONS.—With the 8-inch equatorial and filar micrometer the following objects were observed:—

Object.	Nights of Observation.	No. of Comparisons.
Hebe (6)	4 ...	58
Parthenope (11)	13 ...	125
Niobe (71)	7 ...	122
Procne (194)	14 ...	170
Uranus and 41 Libræ ...	8 ...	213
Neptune and 114 (*o*) Tauri ...	6 ...	120
Totals	52 ...	808

These observations have all been sent to Europe for publication. I am indebted to Professor R. Luther, of Düsseldorf, for M.S. ephemerides of small planets, and to Mr. C. J. Merfield, of Sydney, F.R.A.S., for comparisons of the observations with the ephemerides.

COMET OBSERVATIONS.—The only comet under observation during the year was that discovered by Mr. C. D. Perrine, of the Lick Observatory on 1896, November 2, and distinguished as Comet I., 1897. Early ephemerides of this comet were kindly communicated by Professor H. Kreutz and the discoverer. Observations were commenced on February 23, or as soon as the comet was sufficiently removed from the morning twilight. Morning observations were continued till the second week in

April, by which time the comet could be conveniently observed in the evening. The observations were made with the 8-inch equatorial and square-bar micrometer on 21 nights, and extend from February 23 to April 27. The comet was faint throughout, and did not come up to the expected brightness. Mr. C. J. Merfield has published a set of parabolic elements based on the European and local observations, which is not likely to need much correction.

PHENOMENA OF JUPITER'S SATELLITES.—These were observed with the 8-inch equatorial from February to July, and are classified thus:—Transit ingress—I.3, II.1, III.1. Transit egress—I.4, II.1. Occultation disappearances, I.5. II.3, III.1; Occultation reappearances, III.1, IV.1; Eclipse disappearances, III.1, IV.1; Eclipse reappearances, I.6, II 2, III.1.

VARIABLE STARS.—A series of 29 comparisons was made of *R. Carinæ*, extending from January 4 to August 31.

Meteorological Observations.

These have been regularly made during the year, and comprise observations of the barometer, dry and wet thermometers, the direction and force of the wind, and amount of cloud at 9h. a.m., together with the rainfall and evaporation by two gauges at different heights. In addition to these the daily maximum and minimum temperatures of the air and evaporation, the minimum radiation on the grass and maximum radiation in the sun were observed, together with a continuous register of the direction of the wind. Seven years' meteorological observations are now in hand, to be published as early as possible. When these are published there will be available published data extending over a period of 35 years for investigating the local climate. In consequence of recent local legislation, by which it is tyrannically sought to place the whole burden ot supporting the State upon a small minority of the community, while the great majority are to be exempt from taxation, and yet enjoy all State privileges, it has become necessary for the writer to retrench his annual expenditure. Notice was, therefore, sent to the Minister for Public Instruction on the 11th October last that it was intended at the close of the year to discontinue the meteorological department, and the hope was expressed that the Government would see fit to continue the work at its own expense.

A reply was received, stating that the work would be continued by a member of the scientific staff at the Hawkesbury Agricultural College, about four miles west of the Observatory. After due inquiry at the close of the year it turned out, however that provision had not been made for continuing the Windsor meteorological work in all its departments. It is proposed to continue at this Observatory observations of the daily rainfall by the two gauges, and to secure the monthly maximum and minimum air temperatures.

Publications.

The following communications from the Observatory have appeared in various scientific journals since the publication of the last Report :—

OBSERVATIONS OF MINOR PLANET (8) FLORA, AT THE OPPOSITION OF 1896, DECEMBER.—*Royal Astronomical Society's Monthly Notices*, vol. lvii., p. 496.

DOUBLE STAR MEASURES IN 1896.—*R.A.S. Monthly Notices*, vol. lvii., p. 584.

STAR OCCULTATICNS BY THE MOON, OBSERVED IN 1896. —*Astronomische Nachrichten*, Band cxliii., p. 151.

OBSERVATIONS OF COMET, 1897, I. (Perrine.)—*Ast. Nach.*, Band cxliii., p. 303.

FURTHER OBSERVATIONS OF COMET, 1897, I. (Perrine). *Ast. Nach.*, Band cxliv., p. 79.

OBSERVATIONS OF MINOR PLANET (71) NIOBE at the Opposition of 1897.—*Ast. Nach.*, Band cxliv., p. 239.

OBSERVATIONS OF THE VARIABLE STAR R. CARINÆ, 1895, Dec. 12, to 1896, Aug. 11.—*Journal of the British Astronomical Association*, vol. vii., p. 137.

EQUATORIAL COMPARISONS OF URANUS AND 41 LIBRÆ, &C. —*R.A.S. Monthly Notices*, vol. lviii., p. 21.

OBSERVATIONS OF MINOR PLANET (194) PROCNE AT THE OPPOSITION OF 1897.—*Astronomical Journal*, vol. xviii., p. 92.

The Library.

A list of the presents to this important department of the observatory will be found at the close of the Report. It comprises the gifts of 45 scientific institutions and 25 individuals. The thanks of the writer are cordially presented to the donors.

Personal Establishment.

All the astronomical and nearly all the meteorological observations have been made by the proprietor. The services of Mr. R. B. Walker, of Windsor, have been engaged in some of the reductions.

Observations recently utilized.

The local measures of the more interesting binary stars in the southern hemisphere are turned to good account in Dr. T. J. J. See's splendid work, entitled, "*Researches on the Evolution of the Stellar Systems.*" Some of the measures at Windsor were made expressly for these researches, and were communicated in advance of publication.

The latest observations of Comet III., 1882 (Barnard) were made in December, at the Cape of Good Hope and Windsor, the only southern stations at which it was observed. These observations, that of December 8 made at Windsor being the latest, are employed for a last normal place in the definitive investigation of the orbit by Dr. Leo de Ball. See *Publicationen der v'Kuffner 'schen Sternwarte in Wien.* Band iv., p. B. 59.

The local observations of Minor Planet (61) Danaë, published in *R.A.S. Monthly Notices*, vol. lvii., p. 74, have been employed by Professor R. Luther of Düsseldorf in a redetermination of the orbit of the planet, and have been found to be very consistent, both among themselves and with other positions obtained in Europe. The resulting new elements were published in *Astronomische Nachrichten*, Band cxliv., p. 255.

Pfarrer ~~Professor~~ A. Thraen's *Bestimmung der Bahn des Periodischen Kometen von Wolf (Komet* 1884 III. *und* 1891 II.) has been recently received from the author. It contains an investigation of the elements of this interesting comet from the observations at the return in 1891. The comet was observed at 31 stations in the northern hemisphere, and also at Windsor. The local observations published in *Ast. Nach.*, Band cxxxi., p. 43, occupy a good position among the data employed, and enter into three of the twelve normal places on which the final orbit is based.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1897.

[NOTE.—The names of the donors are printed in italics.]

Results of Rain, River, and Evaporation Observations in New South Wales, 1895; pp. lxxxiii, 199, with maps.

Measures of Double Stars at Sydney Observatory.

The Great Meteor of 1895, May 7, by H. C. Russell, B.A., &c.; pp. 13.

Current Papers, No. 2, by H. C. Russell, B.A., C.M.G.; pp. 6, with table and charts.

The Climate of Lord Howe Island, by H. C. Russell, B.A., &c.; p. 1.

The Government Observatory, Sydney.

The Surveyor. Monthly numbers complete for 1897.

The Institution of Surveyors, New South Wales.

Report of the Public Library of New South Wales for 1896; pp. 8.

The Trustees.

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory for 1896, in two parts.

Thirty-first Report of the Government Astronomer, Melbourne, from 1896, July 1, to 1897, June 30.

The Government Observatory, Melbourne.

Report of the Post Office, Telegraph, and Observatory Departments, Adelaide, 1884-1895; pp. 126.

Meteorological Observations at Adelaide Observatory, &c., in 1894; pp. xiv., 174.

The Government Observatory, Adelaide.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia, 12th session, 1896-97, Vol. XII.; pp. 67.

The Queensland Branch of the Society.

Tables used in the Nautical Almanac Office for the Calculation of Occultations of Stars, &c.; pp. 47.

The Nautical Almanac Office.

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, 1896; pp. 80.

Stonyhurst College Observatory.

Report of the Liverpool Observatory, Bidston, and Meteorological Observations for 1896; pp. 43.

The Liverpool Observatory.

Report of the Kew Observatory for 1896.

The Kew Observatory.

Report of Results of Observations for 1896 at the Fernley Observatory, Southport; pp. 30.

Fernley Observatory, Southport.

Meteorological Observations at Rousdon Observatory, Devon, for 1895, vol. XII.; pp. 82.

The Rousdon Observatory.

Weekly Weather Reports, 1896, November 28, to 1897, November 20.

Monthly Summaries of Observations at Stations in the Daily and Weekly Weather Reports, 1896, September, to 1897, July.

Summary of the Weekly Weather Report, 1896.

Weekly Weather Report, 1896, Vol. XIII., Appendix II.

Quarterly Summaries of the Weekly Weather Reports for 1897. (First three Quarters.)

Meteorological Observations at Stations of the Second Order for 1892, pp. 184; and 1893, pp. 184.

Hourly Means of Self-recording Instruments at the Five Observatories under the Meteorological Council, 1893; pp. 140.

Report of the International Meteorological Conference, Paris, 1896; pp. 90.

Indian Meteorological Memoirs, Vol. VII., Part VI.; and Vol. VIII., Part II.

Report of the Meteorological Council for year ending 1896, March 31; pp. 129.

The Meteorological Office, London.

Edinburgh Circulars, Nos. 51 and 52. Elements and Ephemeris of Comet Perrine, 1896, November 2.

The Royal Observatory, Edinburgh.

Independent Day Numbers for 1897 and 1898, as used at the Royal Observatory, Cape of Good Hope; pp. 12.

Report of H.M. Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for 1896; pp. 18.

New Double Stars found at the Cape Observatory in 1896.

The Royal Observatory, Cape of Good Hope.

Report of the Government Astronomer, Colony of Natal, for 1896; pp. 72.

The Natal Observatory.

Observations and Researches at Hongkong Observatory in 1894, by W. Doberck; pp. 44 and (108).

The Hongkong Observatory.

Monthly Weather Review for 1896, May, to 1897, August, except September, February, and April.

Toronto General Meteorological Register for 1896; pp. 11.

The Meteorological Office, Toronto.

Magnetic Observations at the U.S.N. Observatory, 1894; pp. 118, with plates.

Astronomical, Magnetical, and Meteorological Observations at the U.S.N. Observatory in 1890.

Catalogue of 16748 Southern Stars from Gilliss' Expedition to S. Hemisphere; pp. lxvi. and 420, with plates.

Meteorological Observations and Results at the U.S.N. Observatory for 1890; pp. 57.

The U.S.N. Observatory, Washington.

Fifty-first Annual Report of the Director of the Astronomical Observatory of Harvard College for year ended 1896, September 30; pp. 13.

Astronomical Observatory of Harvard College. Miscellaneous Papers, 1888-95; pp. 15.

Harvard College Observatory. Quarto Publications, 1877 to 1896.

References to Work at Blue Hill Observatory and Discussion of Observations, 1885 to 1890.

Harvard College Observatory, Circular No. 15, pp. 2, with 3 plates; and Circular No. 16.

Annals of the Astronomical Observatory of Harvard College, Vol. XXVIII., Part I. Spectra of Bright Stars, &c.; pp. 128, Vol. XXXVI. Journal of Zone Observations, &c.; pp. 299, and Vol. XXVI. Part II., pp. 91, with plates.

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REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1898,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association; Corresponding Member of the Alliance Scientifique of Paris, of the Queensland Branch of the Royal Geographical Society of Australasia, and of the Sociedad Científica "Antonio Alzate" of Mexico.

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CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY

For 1898.

THE year 1898 was remarkable for the large number of clear nights during the autumn, winter and spring months. A large amount of work was therefore done.

Adopted Position of the Observatory.

Longitude=10h. 3m. 20·5s. E. of Greenwich.
Astronomical latitude= −33° 36′ 30·8″.

Meridian Work.

Sidereal 8-day chronometer, *John Poole,* No. 2962, was employed throughout as the timekeeper, and was regulated as usual by means of the Cooke and Sons' 3-inch transit instrument. The method adopted for the reduction of the transit observations is fully explained in the Report for 1890. The equatorial values of the outer wires of the transit system in sidereal time were adopted throughout as—

A=+20·198s., B=+10·432s., D=−9·334s., E=−19·018s., with a reduction of +0·456s. to the middle wire C for complete transits of an equatorial star. These values were derived from all the transits of circumpolar stars in 1897. The reductions for 1898 were effected as usual by means of tables founded on the above values. The reductions of the transits of circumpolar stars ~~transits~~ during 1898 for equatorial values of the wires were made to keep pace with the transit observations themselves, but no sensible change was detected in the distances of the wires.

The following are the values of the wires from the transits of 1898 :—

A=+20·179s., B=+10·501s., D=−9·326s., E=−19·007s. with a reduction of +0·469s. to the middle wire.

The inclination of the rotation axis of the transit instrument has as usual been subject to gradual variations, but there have not been the very great and sudden changes which characterized the year 1897. The following is a summary of the meridian work during the year :—

Nights on which the local time was determined	... ...	168
Stars observed with a declination not exceeding 40°	...	788
Stars of high declination observed for azimuth	... ...	193
Separate determinations of	level error...	447
	collimation error	42
	azimuth error	142

The following table exhibits the errors of the transit instrument and the errors and rates of the chronometer, *John Poole,* which was also always employed in the extra-meridian department. The right ascensions of both clock and azimuth stars have been taken throughout from the *American Ephemeris*.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—1898.

Mean Solar Day.		No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.				"	"	"		H.	M.	M.	S.	S.	S.
Jan.	29	7	E.W.	+ 5.4	+ 2.0	− 20.51	c Persei, δ Mensæ, E.	4	48	17	19.91		
„	30	7	W.	+ 6.7	[+ 2.1]	− 19.02	γ Hydri, c Persei	4	52	17	22.39	0·108	0.10
„	31	5	W.	+ 7.8	[+ 2.2]	− 18.51	δ Mensæ, α Tauri	4	34	17	24.79	0.101	0.10
Feb.	3	5	W.E.	+ 10.0	+ 2.6	− 18.84	δ Doradûs, α Orionis, W.	6	29	17	33.19	0.114	0.12
„	25	7	E.W.	− 13.0	+ 2.2	− 19.17	ε Geminorum, ζ Mensæ, W.	6	41	18	37.67	0.122	0.11
„	26	4	W.	− 10.7	[+ 2.3]	[− 18.4]		5	47	18	40.18	0.109	0.11
„	27	5	W.	− 9.7	[+ 2.4]	− 17.72	γ^2 Piscis Vol. β Canis Min.	7	44	18	42.96	0.107	0.11
„	28	2	W.	− 8.4	[+ 2.4]	[− 18.1]		5	42	18	45.46	0.114	0.11
Mar.	5	9	W.E.	− 7.8	+ 2.8	− 19.72	ζ Mensæ, 63 Aurigæ, E.	6	34	18	57.13	0.097	0.10
„	30	5	E.W.	+ 4.9	+ 2.4	− 24.95	γ^2 Piscis Vol., δ Gemin. E.	7	58	20	5.09	0.118	0.10
„	31	6	W.	+ 4.8	[+ 2.2]	− 26.00	δ^2 Chamæleontis, ρ^3 Leonis	8	49	20	7.63	0.102	0.10
April	1	6	W.	+ 4.8	[+ 2.0]	− 24.33	γ^2 Piscis Vol., δ Gemin.	8	14	20	9.79	0.092	0.10
„	2	8	W.E.	+ 4.9	+ 1.8	− 22.77	θ Chamæl., γ Cancri, W.	8	56	20	12.31	0.102	0.09
„	3	5	E.	+ 6.9	[+ 1.8]	− 27.67	ζ Chamæleontis, μ Leonis	10	13	20	14.47	0.085	0.11
„	4	5	E.	+ 6.7	[+ 1.7]	− 24.05	θ Chamæleontis, γ Cancri	7	31	20	17.32	0.134	0.16
„	6	8	E.	+ 9.0	[+ 1.6]	[− 24.2]		9	53	20	27.65	0.205	0.17
„	7	5	E.	+ 10.5	[+ 1.6]	− 24.26	30 Monocerotis, θ Chamæl.	7	45	20	30.92	0.150	0.18
„	9	4	E.	+ 12.7	[+ 1.5]	− 24.77	θ Chamæleontis, γ Cancri	8	53	20	37.21	0.128	0.18
„	11	6	E.W.	+ 16.4	+ 1.4	− 24.92	θ Chamæl., γ Cancri, E.	9	16	20	43.60	0.132	0.18
„	14	4	W.	{+ 17.4 − 17.1}	[+ 1.8]	− 22.74	θ Chamæleontis, γ Cancri	9	3	20	52.82	0.128	0.12
„	16	3	W.	− 14.2	[+ 2.1]	{− 22.48 − 25.03}	β Argûs, θ Ursæ Majoris θ Ursæ Majoris, ζ Cham.	9	32	20	58.56	0.118	0.18
„	17	7	W.E.	− 9.4	+ 2.2	{+ 5.27 + 3.33}	θ Chamæl., γ Cancri, W. θ Ursæ Maj., ζ Cham., E.	8	54	21	1.82	0.139	0.18

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.			"	"	"		H. M.	M. S.	S.	S.
April 18	4	E.	− 7.2	[+ 2.3]	+ 2.91	θ Ursæ Maj., ζ Chamæl.	10 23	21 5.08	0.128	0.14
„ 19	4	E.	− 5.2	[+ 2.3]	+ 3.53	θ Ursæ Maj., ζ Chamæl.	9 45	21 8.62	0.151	0.16
„ 21	5	E.	− 1.0	[+ 2.4]	+ 5.50	θ Chamæleontis, γ Cancri	8 32	21 16.57	0.170	0.16
„ 24	9	E.W.	+ 3.3	+ 2.6	− 0.35	θ Ursæ Maj., ζ Cham., W.	9 27	21 27.59	0.151	0.19
„ 26	1	W.	+ 7.1	[+ 2.2]	[+ 0.2]		10 43	21 32.87	0.209	0.20
„ 27	7	W.	+ 9.1	[+ 2.0]	+ 0.50	θ Ursæ Maj., ζ Chamæl.	9 4	21 37.10	0.189	0.16
„ 28	8	W.	+ 10.3	[+ 1.8]	− 0.32	θ Ursæ Maj., ζ Chamæl.	9 0	21 40.21	0.130	0.13
„ 29	6	W.	+ 11.5	[+ 1.6]	− 0.25	θ Ursæ Maj., ζ Chamæl.	8 34	21 43.42	0.136	0.13
„ 30	4	W.E.	+ 12.6	+ 1.4	[− 0.6]		8 11	21 46.50	0.130	0.13
May 7	4	E.	+ 1.3	[+ 1.6]	− 2.81	η Octantis, ν Ursæ Maj.	10 19	22 6.55	0.118	0.15
„ 8	6	E.W.	+ 3.0	+ 1.6	+ 0.68 − 1.34	θ Chamæl., γ Cancri, E. ζ Cham., μ Leonis, W.	9 45	22 10.06	0.150	0.15
„ 9	4	W.	+ 3.6	[+ 1.6]	[− 0.3]		8 14	22 13.57	0.156	0.15
„ 11	2	W.	+ 5.6	[+ 1.5]	[− 0.8]		11 33	22 21.42	0.158	0.15
„ 12	6	W.	+ 6.1	[+ 1.5]	− 0.34	ρ Leonis, δ² Chamæl.	10 39	22 24.81	0.147	0.14
„ 13	5	W.	+ 6.8	[+ 1.5]	− 1.02	β Octantis, S.P., δ² Cham.	10 41	22 27.76	0.123	0.11
„ 14	5	W.	+ 7.8	[+ 1.4]	+ 0.26	β Octantis, S.P., δ² Cham.	10 49	22 30.14	0.099	0.09
„ 15	6	W.E.	+ 7.3	+ 1.4	− 1.39	β Octant., S.P., δ² Cham. E.	10 27	22 32.11	0.083	0.08
„ 16	6	E.	+ 7.1	[+ 1.3]	− 4.24	41 Leonis Min., δ² Cham.	8 55	22 33.75	0.073	0.10
„ 17	3	E.	+ 8.0	[+ 1.3]	[− 3.9]		12 39	22 37.53	0.136	0.13
„ 19	5	E.	+ 9.0	[+ 1.1]	− 3.26	η Octantis, ν Ursæ Maj.	9 51	22 42.70	0.114	0.13
„ 20	3	E.	+ 9.4	[+ 1.1]	[− 2.0]		12 39	22 46.57	0.144	0.13
„ 21	6	E.W.	+ 9.6	+ 1.0	− 1.60 + 0.33	β Oct., S.P., δ² Cham., E. η Oct., ν Ursæ Maj., W.	10 31	22 49.24	0.122	0.14
„ 22	5	W.	+ 11.9	[+ 1.1]	+ 1.37	β Octantis, S.P., δ² Cham.	10 3	22 52.81	0.152	0.16

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors.			Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			Level.	Collimation.	Azimuth.							
1898.			"	"	"		H.	M.	M	S.	S.	S.
May 23	5	W,	+ 10.9	[+ 1.1]	+ 0.69	η Octantis, δ Leonis	12	4	22	56.98	0.158	0.17
„ 24	5	W.	+ 11.5	[+ 1.2]	+ 2.30	β Octantis, S.P , δ^2 Cham.	10	10	22	1.03	0.186	0.20
„ 25	8	W.E.	+ 11.1	+ 1.2	− 1.50	β Octantis, S.P., δ^2 Cham. E.	10	41	23	6.41	0.219	0.20
„ 26	5	E.	+ 10.5	[+ 1.4]	+ 0.13	β Chamæl., β Hydri, S.P.	11	47	23	10.95	0.181	0.17
„ 27	6	E.	+ 10.8	[+ 1.5]	− 2.56	η Octantis, ν Ursæ Maj.	10	11	23	14.43	0.155	0.16
„ 28	8	E.	+ 10.6	[+ 1.7]	− 0.50 − 0.52	β Octantis, S.P., δ^2 Cham. ρ Bootis, α Apodis	13	21	23	18.66	0.156	0.18
„ 29	4	E.	+ 10.8	[+ 1.9]	[− 1.1]		12	6	23	21.08	0.106	0.10
„ 30	2	E.	+ 10.0	[+ 2.1]	[− 1.6]		12	56	23	23.64	0.103	0.09
„ 31	8	E.	+ 10.2	[+ 2.2]	− 2.21	β Octantis, S.P., δ^2 Cham.	12	29	23	25.62	0.084	0.10
June 1	4	E.	+ 10.3	[+ 2.2]	[− 1.4]		11	29	23	28.12	0.109	0.09
„ 2	5	E.W.	+ 10.4	+ 2.4	− 0.49	θ Bootis, α Apodis, E.	15	12	23	30.14	0.078	0.08
„ 4	4	W.	+ 9.4	[+ 2.5]	[− 1.4]		12	48	23	34.57	0.097	0.08
„ 5	5	W.	+ 10.1	[+ 2.5]	− 1.36	β Chamæl., β Hydri, S.P.	11	54	23	36.24	0.072	0.07
„ 7	2	W.	+ 13.3	[+ 2.5]	− 0.28	η Bootis, θ Apodis	14	7	23	39.77	0.070	0.06
„ 9	4	W.E.	+ 19.7 − 4 5	+ 2.6	− 8.99	δ Muscæ, η Bootis, E.	13	26	23	42.82	0.054	0.07
„ 11	8	E.	− 0.1	[+ 2.2]	− 2.30	β Octantis, S.P., δ^2 Cham.	10	45	23	46.38	0.090	0.08
„ 12	5	E.	− 0.2	[+ 2.0]	[− 2.6]		10	20	23	48.28	0.081	0.08
„ 15	4	E.	+ 0.5	[+ 1.3]	− 3.63	β Octantis, S.P., δ^2 Cham.	10	55	23	54.19	0.081	0.07
„ 16	8	E.	+ 0.5	[+ 1.1]	− 4.70	β Chamæl., β Hydri, S.P.	12	20	23	55.98	0.071	0.10
„ 17	2	E.	+ 0.6	[+ 0.9]	[− 4.4]		13	18	23	58.95	0.119	0.12
„ 18	1	E.	+ 0.9	[+ 0.7]	[− 4.0]		10	45	24	1.60	0.124	0.11
„ 19	1	E.	+ 0.9	[+ 0.5]	[− 3.7]		10	27	24	3.95	0.099	0.10
„ 22	4	E.W.	+ 2.2 + 9.0	− 0.4	− 2.66	ρ Octantis, α Cor. Bor , E.	16	7	24	12.04	0.104	0.10

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.			″	″	″		H. M.	M. S.	S.	S.
June 24	5	W.	+ 1.9	[+ 0.4]	+ 0.43	θ Apodis, d Bootis	14 22	24 16.23	0.091	0.11
„ 25	5	W.	+ 2.2	[+ 0.8]	+ 0.16	α Apodis, ε Bootis	15 34	24 19.10	0.114	0.14
„ 26	5	W.	+ 2.2	[+ 1.2]	− 1.06	θ Apodis, d Bootis	14 20	24 22.79	0.162	0.16
„ 27	5	W.	+ 2.2	[+ 1.6]	− 0.10	ρ Bootis, α Apodis	15 13	24 26.47	0.148	0.14
„ 28	5	W.E.	+ 1.6	+ 2.0	+ 0.11	δ Octantis, θ Bootis, W.	15 13	24 29.67	0.133	0.13
July 3	5	E.	+ 1.3	[+ 1.7]	− 1.35	θ Bootis, α Apodis	15 13	24 40.23	0.088	0.08
„ 5	4	E.	+ 1.8	[+ 1.7]	− 0.03	δ Bootis, ρ Octantis	15 19	24 44.01	0.079	0.09
„ 6	8	E.W.	+ 1.8	+ 1.6	+ 2.26	α Apodis, ε Bootis, W.	13 20	24 46.00	0.090	0.09
„ 7	4	W.	+ 1.7	[+ 1.4]	− 0.42	δ Bootis, ρ Octantis	15 57	24 48.44	0.092	0.10
„ 8	2	W.	+ 1.5	[+ 1.2]	[+ 0.5]		13 26	24 50.66	0.103	0.10
„ 10	6	W.	+ 1.4	[+ 0.8]	+ 2.26	ρ Octantis, α Cor. Bor.	13 28	24 55.37	0.098	0.10
„ 11	2	W.	+ 1.2	[+ 0.4]	[+ 1.1]		15 17	24 57.99	0.101	0.09
„ 12	5	W.	+ 1.6	[+ 0.4]	− 1.33 + 1.28	η Ursæ Maj., θ Apodis d Bootis, δ Octantis	14 40	25 0.04	0.088	0.08
„ 13	6	W.E.	+ 0.9	+ 0.2	− 1.74 − 4.03	η Ursæ Maj., θ Apodis, W. θ Bootis, α Apodis, E.	14 28	25 1.94	0.080	0.07
„ 14	5	E.	+ 0.8	[+ 0.6]	− 3.40	ρ Octantis, α Cor. Bor.	16 2	25 3.69	0.068	0.09
„ 15	5	E.	+ 2.1	[+ 1.1]	− 3.14	ρ Octantis, α Cor. Bor.	15 50	25 6.16	0.104	0.10
„ 18	8	E.	+ 1.4	[+ 2.4]	[− 2.3]		18 48	25 13.21	0.094	0.11
„ 19	5	E.W.	+ 1.8	+ 2.8	− 2.40 − 1.64	ρ Bootis, α Apodis, E. ρ Octantis, α Cor. Bor., W.	15 24	25 15.56	0.114	0.11
„ 20	5	W.	+ 1.5	[+ 2.7]	− 1.62	ρ Bootis, α Apodis	15 14	25 18.13	0.108	0.11
„ 21	5	W.	+ 2.4	[+ 2.5]	− 0.14	δ Bootis, ρ Octantis	15 27	25 20.80	0.110	0.13
„ 22	2	W.	+ 1.6	[+ 2.4]	[− 0.4]		16 48	25 24.38	0.142	0.13

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.			"	"	"		H. M.	M. S.	S.	S.
July 24	4	W.	+ 2.2	[+ 2.1]	− 1.66 − 0.33	η Bootis, θ Apodis δ Octantis, θ Bootis	14 26	25 29.73	0.117	0.12
" 26	6	W.E.	+ 1.6	+ 1.8	− 1.13	ρ Bootis, α Apodis, W.	15 36	25 35.72	0.122	0.16
" 27	5	E.	+ 2.0	[+ 1.8]	− 0.96	δ Bootis, ρ Octantis	15 51	25 39.95	0.174	0.19
" 28	6	E.	+ 2.6	[+ 1.8]	− 0.85	δ Bootis, ρ Octantis	16 12	25 44.76	0.198	0.20
" 29	7	E.	+ 3.3	[+ 1.8]	− 2.52	δ^1 Apodis, τ Herculis	15 54	25 49.63	0.205	0.21
" 31	7	E.	+ 2.6	[+ 1.8]	− 0.00	δ Bootis, ρ Octantis	16 10	25 59.79	0.210	0.21
Aug. 1	3	E.	+ 4.9	[+ 1.8]	[+ 0.1]		19 32	26 5.38	0.204	0.21
" 3	3	E.W.	+ 5.0	+ 1.8	[+ 0.4]		17 19	26 14.96	0.209	0.18
" 5	5	W.	+ 4.3	[+ 1.8]	+ 0.73	δ^1 Apodis, τ Herculis	16 16	26 22.36	0.158	0.15
" 8	5	W.	+ 3.5	[+ 1.8]	+ 1.51	δ Bootis, ρ Octantis	16 4	26 32.67	0.144	0.15
" 9	6	W.E.	+ 5.0	+ 1.8	− 0.37	δ^1 Apodis, β Herculis, E.	16 22	26 36.25	0.147	0.15
" 11	4	E.	+ 3.9	[+ 1.6]	[+ 0.8]		18 28	26 44.05	0.156	0.13
" 12	4	E.	+ 3.8	[+ 1.5]	+ 2.22 + 0.66	ι Herculis, γ^2 Sagittarii σ Octantis	18 30	26 46.84	0.116	0.12
" 14	4	E.	+ 3.4	[+ 1.4]	− 1.15	δ Bootis, ρ Octantis	15 39	26 52.07	0.116	0.12
" 16	7	E.W.	+ 3.1	+ 1.2	− 1.13 − 0.11	ϵ Cor. Bor., δ^1 Apodis, E. α Tri. Aust., *d* Herc., W.	16 56	26 58.14	0.123	0.13
" 17	4	W.	+ 3.3	[+ 1.3]	+ 1.94	δ Apodis, τ Herculis	16 25	27 1.16	0.129	0.13
" 19	4	W.	+ 2.8	[+ 1.5]	− 3.12	ϕ Herculis, γ Apodis	17 5	27 7.56	0.131	0.15
" 20	4	W.	+ 2.8	[+ 1.5]	+ 0.38	σ Octantis	19 38	27 11.68	0.156	0.14
" 21	4	W.	+ 4.1	[+ 1.6]	− 0.48	β Herculis, α Tri. Aust.	17 18	27 14.28	0.120	0.12
" 22	5	W.	+ 3.2	[+ 1.7]	− 1.50 − 0.55	α Tri. Aust., *d* Herculis σ Octantis	18 3	27 17.19	0.118	0.12
" 23	6	W.E.	+ 2.9	+ 1.8	− 2.24	σ Octantis, E.	19 9	27 20.26	0.122	0.11

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.			"	"	"		H. M.	M. S.	S.	S.
Aug. 26	5	E.	+ 2.2	[+ 1.9]	— 1.82	σ Octantis	19 48	27 26.86	0.091	0.09
Sept. 2	2	E.	+ 6.9	[+ 2.1]	[— 1.8]		18 29	27 42.27	0.092	0.08
„ 6	5	E.W.	+ 9.6	+ 2.2	[— 1.0]		19 27	27 48.79	0.067	0.12
„ 7	2	W.	+ 10.3	[+ 1.9]	[— 0.9]		20 2	27 52.20	0.139	0.14
„ 8	4	W.	+ 9.7	[+ 1.6]	— 0.84	σ Octantis	20 43	27 55.45	0.132	0.13
„ 10	6	W.	+ 10.6	[+ 1.0]	+ 1.94	σ Octantis	18 54	28 1.71	0.136	0.12
„ 11	6	W.	+ 10.0	[+ 0.7]	+ 1.28	σ Octantis	18 17	28 4.30	0.111	0.12
„ 12	6	W.E.	+ 10.9	+ 0.4	+ 1.57 — 3.50	α Tri. Aust., κ Ophi., W. σ Octantis, E.	18 9	28 7.26	0.124	0.15
„ 13	5	E.	+ 10.3	[+ 0.5]	— 1.85	σ Octantis	18 25	28 11.56	0.177	0.18
„ 14	3	E.	+ 10.1	[+ 0.7]	[— 2.1]		18 32	28 15.92	0.181	0.18
„ 15	5	E.	+ 10.3	[+ 0.8]	— 2.28	σ Octantis	18 38	28 20.38	0.186	0.18
„ 16	5	E.	+ 9.5	[+ 1.0]	— 3.21	σ Octantis	18 9	28 24.27	0.167	0.17
„ 18	4	E.	+ 10.9	[+ 1.3]	[+ 0.7]		18 41	28 32.77	0.175	0.23
„ 19	6	E.W.	+ 9.5	+ 1.4	+ 2.71	ε Pavonis, γ Sagittæ, W.	20 13	28 39.20	0.252	0.23
„ 20	4	W.	+ 8.6	[+ 1.6]	[+ 1.8]		18 24	28 43.63	0.200	0.20
„ 23	4	W.	+ 8.8	[+ 2.0]	— 0.78	σ Octantis	18 38	28 57.57	0.193	0.21
„ 28	5	W.E.	+ 7.9	+ 2.8	+ 2.38	δ Cygni, ε Pavonis, W.	20 28	29 25.14	0.226	0.22
„ 30	4	E.	+ 6.9	[+ 2.5]	+ 2.10	λ^1 Octantis, π^2 Cygni	21 43	29 36.03	0.221	0.21
Oct. 3	4	E.	+ 6.1	[+ 1.9]	+ 2.93	δ Cygni, ε Pavonis	19 59	29 50.06	0.200	0.18
„ 5	3	E.	+ 5.1	[+ 1.6]	+ 3.64	δ Cygni, ε Pavonis	20 2	29 58.05	0.166	0.16
„ 6	4	E.W.	+ 4.1	+ 1.4	+ 2.63	λ^1 Octantis, π^2 Cygni, E.	21 38	30 2.02	0.155	0.17
„ 9	4	W.	+ 3.5	[+ 1.6]	+ 4.69	δ Cygni, ε Pavonis	20 19	30 16.11	0.199	0.22
„ 10	5	W.	+ 2.7	[+ 1.6]	+ 2.63	π^2 Pegasi, υ Octantis	21 31	30 21.72	0.223	0.21
„ 12	2	W.	+ 1.5	[+ 1.8]	[+ 3.2]		21 48	30 31.18	0.196	0.19

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.			"	"	"		H. M.	M. S.	S.	S.
Oct. 15	4	W.	− 1.0	[+ 1.9]	+ 4.12	α Lacertæ, β Octantis	21 52	30 44.05	0.179	0.19
„ 16	6	W.E.	− 1.2	+ 2.0	[+ 4.3]		20 57	30 48.42	0.189	0.20
„ 18	3	E.	− 1.9	[+ 2.0]	[+ 4.8]		21 57	30 58.80	0.212	0.20
„ 21	1	E.	− 2.4	[+ 2.0]	+ 5.44	λ Andromedæ, γ^1 Octantis	0 10	31 12.54	0.185	0.19
„ 23	6	E.W.	− 4.3	+ 2.0	+ 8.83	λ^1 Octantis, π^2 Cygni, W.	21 34	31 21.21	0.191	0.19
„ 27	6	W.	− 7.5	[+ 1.6]	+ 9.81	γ^1 Octantis, 22 Andromedæ	0 34	31 39.29	0.183	0.18
„ 31	4	W.	− 8.9	[+ 1.1]	+ 11.04	λ^1 Octantis, π^2 Cygni	23 53	32 0.75	0.180	0.22
Nov. 1	5	W.E.	− 8.3	+ 1.0	+ 8.76	π^2 Pegasi, υ Octantis, W.	22 43	32 6.12	0.235	0.21
„ 2	2	E.	− 9.5	[+ 1.1]	[+ 8.2]		0 29	32 10.76	0.180	0.18
„ 5	5	E.	− 11.5	[+ 1.2]	+ 6.70	π^2 Pegasi, υ Octantis	22 52	32 22.58	0.168	0.18
„ 9	5	E.W.	− 15.0	+ 1.4	+ 7.37	υ Octantis, α Lacertæ, E.	23 18	32 42.21	0.204	0.24
„ 11	4	W.	− 15.4	[+ 1.8]	[+ 7.6]		22 56	32 54.39	0.255	0.23
„ 12	5	W.	− 16.2	[+ 1.8]	+ 7.74	β Octantis, λ Pegasi	22 36	32 59.69	0.224	0.22
„ 14	6	W.E.	{− 19.1 / + 2.9}	+ 1.2	+ 7.40	λ Androm., γ^1 Octantis, E.	23 14	33 9.82	0.208	0.21
„ 22	8	E.W.	− 5.8	+ 1.4	+ 4.10	β Chamæl. β Hydri, E.	1 0	33 49.55	0.205	0.26
„ 23	7	W.	− 6.0	[+ 1.6]	+ 5.74	γ^1 Octantis, σ Androm.	0 57	33 55.95	0.267	0.26
„ 25	8	W.	− 8.2	[+ 1.9]	+ 5.19	γ^1 Octantis, α Androm.	0 53	34 7.88	0.238	0.26
„ 26	5	W.	− 8.1	[+ 2.0]	+ 5.80	β Chamæleontis, β Hydri	0 43	34 18.90	0.274	0.26
„ 27	12	W.E.	− 9.4	+ 2.2	+ 5.04	λ Androm., γ^1 Octantis, W.	3 33	34 20.42	0.243	0.22
„ 28	4	E.	− 9.0	[+ 2.3]	+ 4.84	γ^1 Octantis, α Androm.	0 47	34 24.55	0.195	0.22
„ 30	3	E.	− 8.9	[+ 2.4]	[+ 5.1]		0 17	34 36.82	0.258	0.26
Dec. 1	3	E.	− 8.8	[+ 2.5]	+ 5.19	γ^1 Octantis, α Androm.	0 34	34 43.17	0.262	0.26
„ 2	2	E.	− 8.5	[+ 2.6]	[+ 5.1]		0 37	34 49.29	0.254	0.25
„ 8	5	E.W.	{− 7.4 / − 9.7}	+ 3.0	+ 4.82	β Hydri, π Androm., E.	1 10	35 20.20	0.214	0.29

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1898.			"	"	"		H. M.	M. S.	S.	S.
Dec. 9	2	W.	− 7.6	[+ 2.9]	[+ 4.6]		1 16	35 27.51	0.303	0.30
„ 10	3	W.	− 6.7	[+ 2.8]	+ 4.77	β Hydri, π Androm.	0 54	35 34.49	0.296	0.27
„ 11	2	W.	− 6.8	[+ 2.7]	[+ 4.3]		4 39	35 41.38	0.248	0.25
„ 13	3	W.	− 5.8	[+ 2.4]	+ 3.43	β Androm., κ Tucanæ	1 34	35 52.45	0.246	0.25
„ 17	4	W.E.	− 4.0	+ 2.0	+ 3.10	β Androm., κ Tucanæ, W.	2 1	36 15.85	0.243	0.23
„ 21	5	E.	− 2.7	[+ 2.0]	+ 2.31	γ Trianguli, δ Hydri	2 25	36 36.96	0.219	0.20
„ 26	4	E.W.	− 2.5	+ 2.0	+ 2.73	μ Hydri, σ Arietis, E.	3 33	36 59.87	0.181	0.20
„ 27	4	W.	− 2.1	[+ 2.0]	+ 4.56	μ Hydri, σ Arietis	2 56	37 4.57	0.201	0.19
„ 28	4	W.	− 2.3	[+ 2.0]	+ 4.80	γ Trianguli, μ Hydri	3 7	37 8.96	0.182	0.19
„ 29	5	W.	− 1.0	[+ 2.0]	+ 4.38	γ Trianguli, μ Hydri	2 36	37 13.73	0.203	
„ 31		W.E.	− 1.3	+ 2.0						

NOTES.

January 29th—First observations since the end of 1897. Eastern pivot raised 28.5" before the observations
February 25th—Eastern pivot raised 37.4" before the observations.
March 30th—Eastern pivot lowered 25.0" before the observations.
April 14th—Eastern pivot raised during the observations.
April 16th—Instrument adjusted for azimuth after the observations. It was found that by this adjustment the eastern pivot had been lowered 3.8"
April 30th—A transit could not be observed with clamp east.
May 4th—Shortly before sunset the level error was + 12.7", but clouds prevented transit work.
May 5th—In the evening the level error was + 12.8", but transits could not be observed.
May 7th—Eastern pivot raised 25.0" before the observations. 4.526 inches of rain were recorded for 24 hours on May 5 days 21 hours.
June 9th—Eastern pivot raised 24.2" during the observations.
June 22nd—Level error greatly changed on reversing the instrument. On thoroughly cleaning the pivots and segmental bearings on the following day the error returned to its previous value.
August 3rd—Clouds prevented an observation with clamp west.
September 3rd—2.257 inches of rain fell in 4 days, ended Sept. 2 days 21 hours.
October 22nd—2.971 inches of rain fell in 48 hours, ended Oct. 21 days 21 hours.
November 14th—Eastern pivot lowered 20.6" during the observations.
December 8th—Level error slightly changed by reversal.
December 31st—Clouds prevented observations after the 29th. Collimation error determined on the 31st.

Extra-Meridian Work.

OCCULTATIONS OF STARS BY THE MOON:—Thirty-six disappearances were observed, chiefly with the eight-inch equatorial, at the moon's dark limb. Of the occulted stars, twenty-eight were identified and found to be well determined. For the remaining stars, data are afforded for fixing their approximate places. The region of sky traversed by the moon during 1898 was remarkably barren. The results have been sent to the *Astronomische Nachrichten.*

PLANET OBSERVATIONS:—The following objects were observed with the Grubb filar micrometer on the eight-inch equatorial.

Object.	Nights of Observation.	Comparisons.	Comparison Stars.
(4) Vesta	6	73	3
(7) Iris	16	211	3
(42) Isis	8	107	4
Jupiter and η Virginis	7	91	1
Uranus and ω^1 Scorpii	10	132	1
Uranus and ω^2 Scorpii	10	132	1

The observations of the first three planets have already appeared in the *Astronomische Nachrichten.* Those of *Vesta* and *Isis* have been compared by Mr. C. J. Merfield, F.R.A.S., with the ephemerides in the *Nautical Almanac* and the *Berliner Astronomische Jahrbuch,* and those of *Iris* by Dr. J. Riem of the Recheninstitut, Berlin, with an accurate ephemeris provided by him for the purpose. All the observed positions have turned out extremely satisfactory. The consistency of the results depends of course in a great measure on the excellent authorities available for the places of the comparison stars. The observations of *Jupiter* and *Uranus* have been forwarded to the Royal Astronomical Society.

COMET OBSERVATIONS:—After two or three cloudy evenings, Encke's Comet was found on the evening of June 11, with the four-and-a-half-inch equatorial and close to the position assigned to it by Iwanow's ephemeris. It presented itself as a well condensed nebula, close to the band of twilight along the western horizon. There was no time for applying a micrometer, but on the following evening I obtained three comparisons

with a square bar-micrometer on the small equatorial. Similar comparisons were made on June 15. Observations were then discontinued till the comet should be high enough to be observed with the eight-inch instrument. On looking again for the comet on June 25, with a ring-micrometer eye-piece adapted to the four-and-a-half-inch telescope, I was surprised to find that, notwithstanding a beautifully clear sky, the object was invisible. On the following evening, it was seen as an extremely faint patch of light close to the place indicated by the ephemeris. Several attempts were made to observe it with the large equatorial, but in vain. It was altogether too faint for micrometer work. Instead of the comet becoming brighter according to expectation, it rapidly became expanded and diffused, and its variations of apparent brilliancy were of course quite inconsistent with the accepted formula for calculating the apparent intensity of a comet's light. The two positions obtained have already appeared in the *Astronomische Nachrichten.*

The cable message announcing the discovery of the Comet Coddington-Pauly reached the Observatory on June 14. The first position obtained was with the square bar-micrometer on the eight-inch equatorial on June 15. From that date to the close of the year the comet was followed by means of the same instrument. During the year it was observed on 80 nights, the number of comparisons being 612, and that of the comparison stars, 105. During the current year, however, it was still observed as often as the moon and the weather permitted, the last position being obtained on March 3. It was then of the last degree of faintness. The whole series of observations, June 15 to March 3, comprises 103 nights, 764 comparisons, and 138 comparison stars. The series of observations thus completed, exceeds in length that obtained at this Observatory for any previous comet. Comet VI., 1892 (Brooks) was observed on 62 nights from 1892, November 28, to 1893, June 19, and the Great Comet II., 1882, on 55 nights, from 1882, September 8th, to 1883, March 2nd. I am indebted to several astronomers for ephemerides of Comet Coddington-Pauly, especially to Mr. C. J. Merfield, of Sydney, F.R.A.S., who has from time to time furnished me with predicted positions down to 1899, March 14, based on elements derived by himself from extended local observations. Attempts were made to observe

comets *e* and *h*, 1898, discovered by Perrine, but the difference of right ascension of the sun and comets was not sufficiently great to admit of either comet being seen on a dark sky.

SUNDRY OBSERVATIONS:—Under this head it may be mentioned that a series of observations of phenomena of Jupiter's Satellites was also made, together with a few comparisons of the variable *R. Carinæ*.

Meteorological Observations.

During the past year the only observations in this department were those of the highest and lowest shade temperatures, the highest solar and lowest terrestrial radiation for each month, together with the daily rainfall by two gauges. The following are the results for comparison with the monthly values obtained for this Observatory during the period 1863-97:—

1898.	Temperatures.				Rainfall.			
	Highest Shade.	Lowest Shade.	Highest in Sun, Black Bulb in Vacuo.	Lowest Radiation on Grass.	Gauge 6.8 feet above Ground.	Gauge 22.0 feet above Ground.	Greatest Daily Fall by Lower Gauge.	Date 9h. a.m.
	°	°	°	°	Inches.	Inches.	Inches.	
January ...	108.0	54.6	154.5	50.7	4.512	4.317	1.499	25
February ...	107.7	54.3	153.0	49.5	3.658	3.183	1.754	14
March	96 5	45.7	146.0	41.7	0.930	0.905	0.235	28 & 29
April	92.6	37.1	136.7	31.5	0.153	0.154	0.121	12
May	77.0	29.5	122.8	25.2	5.423	5.224	4.526	6
June	74.3	31.3	112.2	29.7	4.135	4.048	1.645	8
July	76.6	26.1	113.2	24.7	1.115	1.079	0.488	24
August	84.2	32.4	127.0	28.2	2.267	2.174	1.052	31
September ...	94.7	36 6	139.0	32.6	1.587	1.496	0.705	1
October... ...	104.0	36.5	153.3	34.6	3.059	2.948	1.540	22
November ...	106.0	45.5	153.2	37.7	0.339	0.327	0.138	21
December ...	116.4	44.5	160.1	39.8	0.900	0.871	0.446	24
Year ...	116.4	26.1	160.1	24.7	28.078	26.726	4.526	May 6

The instruments employed in obtaining the above results, are those used for the same purpose during the period 1891—97 (see the volume of Meteorological Results for that period). The indications of the shade thermometers have been corrected to the standard thermometer, No. 2661, by means of a few comparisons taken during each month, the corrections for the grass radiation thermometer, F. and R., are the means of the

resulting monthly corrections for 1891—97 (see introduction, page V. of the volume just referred to). No corrections have been applied to the sun thermometer No. 44045. Meteorological observations similar to those in the above table will also be obtained for the year 1899.

Publications.

The following communications from the Observatory have appeared in scientific journals since the publication of the last Report :—

EQUATORIAL COMPARISONS OF NEPTUNE WITH 114 (*o*) TAURI, December, 1897—*Royal Astronomical Society's Monthly Notices,* Vol. LVIII., p. 327.

EQUATORIAL COMPARISONS OF (6) HEBE, (11) PARTHENOPE AND (194) PROCNE WITH NEIGHBOURING STARS IN 1897—*Astronomische Nachrichten, Band* CXLVI., p. 9.

STAR OCCULTATIONS BY THE MOON OBSERVED IN 1897—*Astronomische Nachrichten, Band* CXLVI., p. 219.

OBSERVATIONS OF PHENOMENA OF JUPITER'S SATELLITES IN 1897—*Royal Astronomical Society's Monthly Notices,* Vol. LVIII., p. 464.

EQUATORIAL COMPARISONS OF (4) VESTA, (7) IRIS, (42) ISIS, AND ENCKE'S COMET WITH NEIGHBOURING STARS IN 1898—*Astronomische Nachrichten, Band* CXLVII., p. 313.

EQUATORIAL COMPARISONS OF COMET CODDINGTON-PAULY (*c* 1898), June 15 to October 18—*Royal Astronomical Society's Monthly Notices,* Vol. LIX., p. 93.

The Meteorological observations for the period 1891—97 were also published and distributed during the year.

The Library.

The donations to this important department of the Observatory comprise the gifts of 46 scientific institutions, and 17 individuals. A list of all the presents during the year will be found at the close of the Report. The thanks of the proprietor are hereby tendered to the various donors.

Personal Establishment.

All the observations for 1898, both astronomical and meteorological, have been made by the proprietor. In consequence of the extreme difficulty in getting occasional assistance in the work of computing, nearly all the reductions have also devolved upon him. The work indeed has been so heavy during the year, that it will be necessary for him to relax his efforts during the current year.

May 1st, 1899.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1898.

[NOTE.—The names of the Donors are printed in italics.]

Measures of Double Stars at Sydney in 1896; pp. 5.

The Aurora Australis, by H. C. Russell, B.A., F.R.S., &c.; pp. 8.

Icebergs in the Southern Ocean, No. 2, by same; pp. 31, with plates.

Waterspouts on the Coast of New South Wales, by same; pp. 18, with plates.

Source of the Periodic Waves recorded on the Sydney and Newcastle Tide Gauges, by same; pp. 6.

Results of Rain, River, and Evaporation Observations in New South Wales in 1896, with maps; pp. liii., and 209.

The Government Observatory, Sydney.

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory, &c., January 1 to June 30, 1897.

Thirty-second Report of the Government Astronomer, Melbourne, 1897, July 1, to 1898, June 30; pp. 8.

The Government Observatory, Melbourne.

Meteorological Observations at Adelaide Observatory, and Other Places in South Australia, &c., for 1895.

The Government Observatory, Adelaide.

Meteorological Report of the Government Astronomer, Perth, Western Australia, for 1894; pp. 18, with diagrams.

The Government Observatory, Perth.

The Surveyor for 1898. Twelve monthly numbers complete.

The Institution of Surveyors, New South Wales.

Weekly Weather Reports, 1897, November 27, to 1898, November 19; complete, with title and preface.

Weekly Weather Report, 1897, Vol. XIV., Appendix II.

Summary of the Weekly Weather Report, 1897, Vol. XIV., Appendix II. Values for the whole year.

Quarterly Summaries of the Weekly Weather Report, 1897, 4th Quarter, October to December; 1898, 1st Quarter, January to March; 2nd Quarter, April to June.

Summary of Observations at Stations in the Daily and Weekly Weather Reports, 1897, August to December; 1898, January to July, inclusive.

Report of the Meteorological Council for year ending 1897, March 31; pp. 123.

Hourly Means of the Self-recording Instruments at the Five Observatories under the Meteorological Council, 1894; pp. 140.

Meteorological Observations at Stations of the Second Order for 1894; pp. 184.

Rainfall Tables of the British Islands, 1866-1890; pp. 283.

Indian Meteorological Memoirs, Vol. VII., Part VII.; pp. 877 to 1017.

The Meteorological Office, London.

Annals of the Cape Observatory, Vols. III. and IV., containing the Cape Photographic Durchmusterung, Vols. I and II.

Annals of the Cape Observatory, Vols. VI. and VII., containing a Determination of the Solar Parallax and Mass of the Moon from Heliometer Observations of Iris, Victoria, and Sappho in 1888 and 1889 at the Royal Observatory, Cape of Good Hope, and Other Places. *The Lords Commissioners of the Admiralty.*

Twenty-third Annual Report of the Oxford University Observatory, 1897-98; pp. 10. *The Oxford University Observatory.*

Astronomical Observations at the Cambridge Observatory, Vol. XXIII., for 1872-3-4-5; pp. xxix. and 428.

Report of the Cambridge Observatory for 1897, May 26 to 1898, May 25; pp. 9. *The Cambridge University Syndicate.*

Report of the Liverpool Observatory, Bidston, Birkenhead and Meteorological results for 1897; pp. 39. *The Liverpool Observatory.*

Report of the Kew Observatory for 1897; pp. 33.

The Kew Observatory.

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, with Report for 1897; pp. 82.

The Spectrum of *o Ceti* photographed at Stonyhurst Observatory, by Rev. W. Sidgreaves; pp. 11, with plates.

Stonyhurst College Observatory.

Report and Results of Observations for 1897; pp. 29, with plate.

Meteorological Department, Southport.

Reports of the Temple Observatory for 1896 and 1897; pp. 3 and 3.

The Temple Observatory.

Meteorological Observations at Rousdon Observatory, Vols. XIII. and XIV., for 1896 and 1897; pp. 35 and 38.

Variable Star Notes, Nos. 2 and 3, 1887-96, by C. E. Peek, M.A., &c.; pp. 20 and 19. *The Rousdon Observatory, Devon.*

Appendix to Cape Meridian Observations, 1890-91, Star Correction Tables, by W. H. Finlay, M.A.

Results of Meridian Observations at the Royal Observatory, Cape of Good Hope, during 1861-2-3-4-5; pp. xv. and 393.

Cape of Good Hope Meridian Observations of Stars, 1892 to 1895; pp. xx. and 235. *The Astronomer Royal for England.*

Independent Day Numbers for 1898 (pp. 15) and 1899-1900 (pp. 28), as used at the Royal Observatory, Cape of Good Hope.

Report of Her Majesty's Astronomer at the Cape of Good Hope for 1897; pp. 18. *The Royal Observatory, Cape of Good Hope.*

Report of the Government Astronomer, Colony of Natal, for 1897; pp. 67. *The Natal Observatory.*

Report of the Madras Observatory for 1897-98, and on the Eclipse Expedition, January, 1898; pp. 29. *The Madras Observatory.*

Observations and Researches at the Hongkong Observatory in 1896 and 1897, by W. Doberck; 2 vols.

The Law of Storms in the Eastern Seas, by W. Doberck; pp. 39, with plates. *The Hongkong Observatory.*

Monthly Weather Review from 1897, September, to 1898, August.

Report of the Meteorological Service of Canada for 1890; pp. xliv. and 322.

Report of same for 1895; with maps.

Toronto General Meteorological Register for 1897; pp. 11. *The Meteorological Office, Toronto.*

Report of the U.S. Naval Observatory for year ended 1894, June 30; pp. 7.

Report of same for year ending 1897, June 30; pp. 16. *The U.S. Naval Observatory.*

Fifty-second Annual Report of the Observatory of Harvard College for the year ended 1897, September 30; pp. 13. *Harvard College Observatory.*

Report of the Yale University Observatory for 1896-97; pp. 23.

Report of same for 1897-98; pp. 22. *Yale University Observatory.*

American Ephemeris and Nautical Almanac for 1900, 1st Ed.; pp. 551.

Vol. VI., Part IV. of Astronomical Papers for the use of the American Ephemeris, &c., Tables of Mars; pp. 385 to 586. *Office of the American Ephemeris.*

First Catalogue of New Double and Multiple Stars in the Southern Hemisphere discovered at the Lowell Observatory; pp. 38. *The Lowell Observatory.*

A Thermograph, by G. M. Eldridge; pp. 5, with plate.

Annual Report of the Director of the Drawing School of the Franklin Institute, 1896-97; pp. 2.

Work of the Committee on Fire Proofing Tests, by S. A. Reed, Ph.D.; pp. 15, with plates. *The Franklin Institute.*

Rapport Annuel sur l'Etat de l'Observatoire de Paris pour 1897; pp. 35. *The Paris Observatory.*

Genäherte Oppositions-Ephemeriden von 45 kleinen Planeten für 1898, Januar bis August; pp. 16.

Planeten Elemente nebst Angaben über die Oppositionen und Oppositions-Ephemeriden kleiner Planeten für 1898; pp. 90.

Genäherte Oppositions-Ephemeriden von 49 kleinen Planeten für 1898, August bis December, pp. 16. *Koniglichen Recheninstitut, Berlin.*

Bericht über den Stand der Erforschung der Breiten-variation im December, 1897, von Th. Albrecht; pp. 36, with plate.

Central Bureau der Internationalen Erdmessung, Berlin-Potsdam.

Catalog von 636 Sternen nach Beobachtungen am Meridiankreise der Hamburger Sternwarte, von W. Luther; pp. 63.

The Hamburg Observatory.

Ableitung relativer Oerter des Mondes gegen die Sonne, &c., von W. Schur; pp. 26, with plate. *The Royal Observatory, Gottingen.*

Meteorologische Termin-Beobachtungen in Pola und Sebenico; 1897, Oct., Nov., Dec.; 1898, Jän, Feb., März, April, Mai, Juni, Juli und Sept.

Monats und Jahresübersicht nach den Termin-Beobachtungen in Pola und Sebenico, 1897.

Jahrbuch der Meterologischen und Erdmagnetischen Beobachtungen, Beob. des Jahres, 1897; pp. xxxviii. and 168, with plates.

Hydrographische Amt in Pola.

Die Kön. ung. Reichsanstalt für Meteorologie und Erdmagnetismus in Budapest und das Kön ung. Meterologische und Physicalische Observatorium in O-Gyalla, von Dr. N. T. E. von Konkoly; pp. 51, with plates.

Beobachtungen angestellt am Astrophysikalischen und Meteorologischen Observatorium in O-Gyalla, 1894-5; pp. 78.

Jahrbücher der Königl. ung. Reichsanstalt für Meteorologie und Erdmagnetismus, Band XXV., Jahrgang, 1895 (pp. 155), and Band XXVII., Jahrgang, 1897.

Astrophysical and Meteorological Observatory, O-Gyalla.

Magnetische und Meteorologische Beobachtungen an der k. k. Sternwarte zu Prag., im Jahre 1897; pp. xvi. and 41.

The Prague Observatory.

J. Scheiner, Untersuchungen über die Spectra der helleren Sterne nach photographischen Aufnahmen, von N. C. Dunér; pp. 21.

The Upsal Observatory.

Annalen der Sternwarte in Leiden, Siebenter Band; pp. 337, with plates.

The Leyden Observatory.

Osservazioni di Stelle Variabili eseguite a Torino e a Soperga, Mem. di F. Porro; pp. 281 to 336.

La Durata dello Splendere del Sole sull'orizzonte di Torino, Nota del Dr. G. B. Rizzo; pp. 9, with plates.

Effemeridi del Sole e della Luna per l'orizzonte di Torino, 1898, Dr. V. Balbi; pp. 19.

Osservazioni Meteorologiche fatte nell 'anno 1895 all 'Osservatorio della R. Universita di Torino, Dr. G. B. Rizzo; pp. 53.

Same for 1896; pp. 53. *The University Observatory, Turin.*

Osservazioni Astronomiche fatte all 'Equatoriale di Arcetri nel 1897, da A. Abetti; pp. 40.

Posizioni di 21 Stelle fra la 5*a* e 7*a* grandezza al Cerchio Meridiano di Padova, da A. Antoniazzi e B. Viaro; pp. 56.

Il Piccolo Meridiano di Arcetri, primi studi di A. Abetti; pp. 82, with plate.

R. Istituto di Studi Superiori Pratici e di Perfezionamento in Firenze.

No. VIII (1892-1893) Work in Russian Text; pp. 29, with plate.

The Observatory, Kazan.

Annuario publicado pelo Observatorio do Rio de Janeiro, 1897; pp. viii., 244. *The Imperial Observatory, Rio de Janeiro.*

Memorias y Revista de la Sociedad Cientifica "Antonio Alzate;" Tomo X. (1896-7), Nos. 5 to 12; Tomo XI. (1897-1898), Nos. 1 to 12.

Central Meteorological and Magnetical Observatory, Mexico.

Boletin del Observatorio Astronomico Nacional de Tacubaya, Tomo II., Nos. 2, 3 and 4; pp. 37 to 142.

Anuario del Observatorio Astronomico Nacional de Tacubaya, 1898; pp. 459. *The National Observatory, Tacubaya.*

Boletin Mensual Meteorologico y Agricola del Observatorio Central del Estado de Vera Cruz Llave, 1897, Julio-Noviembre.

The Central Meteorological Observatory, Vera Cruz.

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Tomo I., 1897-98, Resumen General.

The Meteorological Observatory, Oaxaca.

Publications of the Earthquake Investigation Committee, Preliminary Report on the Variation of Latitude at Tokyo, 2nd Series, by H. Kimura.

Same, No. 2, by H. Kimura.
Earthquake Investigation Committee, Tokyo,

Note on the Cubic Parabola Applied as a Transition to Small Tramway Curves, by C. J. Merfield, F.R.A.S.; pp. 5.

Right Ascensions and Declinations and Probable Proper Motions of Eight Stars in Aquarius, by same; pp. 5. *The Author.*

Handbook of Sydney and the County of Cumberland, by W. H. Hamlet, F.I.C., &c.; pp. 198.

The Molecular Mechanism of an Electrolyte, by same. (Abstract.)
The Author.

Aeronautics, by L. Hargrave; pp. 11, with plates. *The Author.*

The Astronomical Journal, No. 425.
H. Wright, Free Public Library, Sydney.

Queensland, by J. P. Thomson, F.R.S.G.S., &c.; pp. 561 to 635, with map and plates. *The Author.*

Wragge's Australasian Weather Guide and Almanac for 1898.; pp. 328.
N. Sapsford.

President's Address, Section A, Aust. Association for the Advancement of Science, by P. Baracchi; pp. 19. *The Author.*

Remarkable Comets, by W. T. Lynn, B.A., &c., 6th ed.; 1898, pp. 44.
Remarkable Eclipses, by same; 3rd ed., pp. 52. *The Author.*

A Catalogue of the Magnitudes of 1081 Stars, between —30° Declination and the South Pole, from Observations in 1885-6, by A. Stanley Williams; pp. xi., 43. *The Author.*

The Ternary System, Lacaille, 7215 = h 4935, by R. T. A. Innes, F.R.A.S.; pp. 3.

Astronomical Journal, Nos. 396, 417, 425, and 436.
R. T. A. Innes, F.R.A.S.

The Monist, Vol. I., No. 3, April, 1891, and Vol. V., No. 2, January, 1895. *The Open Court Publishing Company, Chicago.*

Zusammenstellung der Kometen-Erscheinungen des Jahres 1897, von H. Kreutz; pp. 6. *The Author.*

Bestimmung der Bahn des Periodischen-Kometen von Wolf, Komet 1884, III., and 1891, II., von A. Thraen; pp. 43. *The Author.*

Annales de l'Observatoire de Nice; Tome VI. *R. L. Bischoffsheim.*

Osservazioni Astronomiche e fisiche sull' asse di rotazione e sulla topografia del Pianeta Marte, &c., G. V. Schiaparelli; pp. 50, with plates. *The Author.*

Marte nel 1896-97, con 3 tavole, V. Cerulli, pp. 126, with plates. *The Author.*

Tesis Inaugural que para el examen profesional de Medicina, Cirugia, y Obstetricia, Augustin M. Dominguez; pp. 71. *The Author.*

ERRATA.

In the Report for 1896—

Page 26, line 27 from top, *insert* 94 *between* 93 and 95.

In the Report for 1897—

Page 17, line 10 from bottom, *for* Professor *read* Pfarrer.

Page 22, line 21 from top, *for* Instituto *read* R. Istituto; and *for* Practici *read* Pratici.

Page 24, line 8 from bottom, *for* Pineta, *read* Pianeta.

Turner and Henderson, Printers, 254 George Street, Sydney—22091.

Ann Arbor Observatory.
Michigan.
The United States

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1899.

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association.
Corresponding Member of the Alliance Scientifique Universelle of Paris, of the Queensland Branch of the Royal Geographical Society of Australasia, and of the Sociedad Cientifica "Antonio Alzate" of Mexico.

SYDNEY:
TURNER AND HENDERSON,
254 GEORGE STREET.

1900.

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1900.

CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY

For 1899.

THE observing weather was also very favourable during the year 1899, and the results obtained are quite equal to those reported for any former year.

Adopted Position of the Observatory.

Longitude=10h. 3m. 20·5s. E. of Greenwich.

Astronomical latitude= $-33^\circ\ 36'\ 30{\cdot}8''$.

Height of barometer cistern above the local mean tidal level=52 feet.

Meridian Work.

The local sidereal time was kept by 8-day chronometer, *John Poole,* No. 2962, which was regulated by means of the Cooke and Sons' 3-inch transit instrument. The method adopted in the reduction of the transit observations is fully described in the Report for 1890. The equatorial distances in sidereal time of the outer wires of the transit system from the middle wire as determined from all the transits of circumpolar stars during 1898 are—

A=+20·179s., B=+10·501s., D=−9·326s., E=−19·007s., with a reduction of +0·469s. to the middle wire when all five wires were observed, and these values were employed and remained practically undisturbed during 1899. A reduction

of all the transits of circumpolar stars for 1899 gives the following for the equatorial values of the wires:—

A=+20·189s., B=+10·494s., D=−9·319s., E=−19·014s. with a reduction of +0·470s. to the middle wire.

The following is a summary of the work during 1899:—

Nights on which the local time was determined		195
Transits observed of stars with a declination not exceeding 40°		975
Transits of stars of high declination observed for azimuth		239
Separate determinations of	level error...	575
	collimation error	51
	azimuth error	170

The usual table is here given showing the errors of the transit instrument and the errors and rates of the chronometer, *John Poole,* which was also always employed in the extra-meridian department. The right ascensions of both clock and azimuth stars have been taken throughout from the *American Ephemeris.* The sidereal times of the extra-meridian observations have been converted into the corresponding mean solar times by adopting the sidereal time at Greenwich mean noon of the *British Nautical Almanac* diminished by 1m. 39·12s., and the results have been checked as usual by the use of the Greenwich mean time of the preceding transit of the First Point of Aries from the same work increased by 1m. 38·84s.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—1899.

Mean Solar Day.		No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1899.				"	"	"		H. M.	M. S.	S.	S.
Jan.	1	5	E.	0.0	[+ 2.1]	+ 4.30	γ Trianguli, μ Hydri	2 54	37 25.35	0.161	0.14
„	2	5	E.	+ 0.2	[+ 2.1]	+ 4.57	μ Hydri, σ Arietis	2 52	37 28.47	0.130	0.17
„	3	4	E.	+ 0.4	[+ 2.2]	+ 4.85	μ Hydri, σ Arietis	3 12	37 33.41	0·203	0.22
„	4	5	E.	+ 1.3	[+ 2.3]	+ 5.42	μ Hydri, σ Arietis	2 44	37 39.10	0.242	0.24
„	5	2	E.	+ 2.9	[+ 2.3]	[+ 6.1]		2 42	37 44.60	0.229	0.24
„	6	5	E.W.	+ 3.2	+ 2.4	+ 6.68	μ Hydri, σ Arietis, W.	3 1	37 50.91	0.259	0.24
„	7	3	W.	+ 4.7	[+ 2.4]	+ 6.40	μ Hydri, σ Arietis	3 14	37 56.44	0.228	0.21
„	9	4	W.	+ 6.7	[+ 2·5]	+ 5.42	μ Hydri, σ Arietis	3 7	38 4.84	0.175	0.18
„	12	7	W.E.	+ 10.0	+ 2.6	− 0.10	β Persei, ι Hydri, W.	3 54	38 18.94	0.194	0.26
„	13	4	E.	+ 11.3	[+ 2.6]	+ 0.36	β Persei, ι Hydri	3 40	38 25.75	0.286	0.27
„	14	3	E.	+ 12.7	[+ 2.6]	[+ 0.4]		6 39	38 32.50	0.250	0.24
„	15	4	E	+ 13.3	[+ 2.6]	+ 0.43	ζ Arietis, ι Hydri	4 10	38 37.52	0.233	0.21
„	16	5	E.W.	+ 13.9	+ 2.6	− 0.10	β Persei, ι Hydri, E.	4 5	38 41.93	0.184	0.20
„	19	4	W.	+ 13.2	[+ 2.6]	− 2.61	ι Hydri, *f* Tauri	4 5	38 58.60	0.232	0.24
„	20	3	W.	+ 13.4	[+ 2.5]	− 1.23	ι Hydri, δ Persei	4 11	39 4.55	0.247	0.24
„	30	3	W.	+ 17.9	[+ 2.4]	− 2.71	ϵ Geminorum, ζ Mensæ	7 11	39 51·81	0.194	0.25
Feb.	1	7	W.E.	{+ 18.6 − 6.0}	+ 2.4	− 0.62	δ Mensæ, τ Tauri, W.	5 9	40 3.70	0.259	0.26
„	2	4	E.	− 5.7	[+ 2.3]	[− 1.4]		4 33	40 9.88	0.264	0.25
„	3	4	E.	− 4.4	[+ 2.3]	− 2.15	δ Mensæ, τ Tauri	4 54	40 15.65	0.237	0.23
„	6	3	E.	− 1.8	[+ 2.2]	[− 3.0]		5 55	40 32.30	0.228	0.24
„	9	6	E.W.	− 0.5	+ 2.0	− 3.76	δ Mensæ, τ Tauri, E.	5 25	40 50.15	0.250	0.21
„	10	5	W.	+ 0.8	[+ 2.2]	− 2.43	δ Mensæ, τ Tauri	5 32	40 54.73	0.190	0.19
„	13	6	W.E.	+ 2.5	+ 2.6	− 3 64	δ Doradûs, β Aurigæ, E.	5 38	41 8.41	0.190	0.19
„	14	4	E.	+ 2.0	[+ 2.3]	− 3.28	δ Mensæ, τ Tauri	5 30	41 12.92	0.189	0.17
„	15	3	E.	+ 3.0	[+ 1.9]	[− 3.6]		5 37	41 16.45	0.146	0.15

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H.	M.	M.	S.	S.	S.
1899.												
Feb. 16	6	E.W.	+ 4.4	+ 1.6	− 3.97	δ Doradûs, β Aurigæ, W.	5	45	41	20.11	0.152	0.15
„ 17	5	W.	+ 5.6	[+ 1.7]	[− 3.9]		5	55	41	23.48	0.139	0.12
„ 18	6	W.	+ 6.3	[+ 1.8]	− 3.77	ψ^5 Aurigæ, ζ Mensæ	6	29	41	26.13	0.108	0.12
„ 22	2	W.	+ 4.7	[+ 2.3]	[− 5.2]		9	58	41	41.38	0.153	0.15
„ 23	5	W.E.	+ 4.4	+ 2.4	− 5.59	δ Doradûs, β Aurigæ, W.	6	19	41	44.30	0.143	0.16
„ 24	3	E.	+ 5.5	[+ 2.3]	[− 5.5]		6	23	41	48.63	0.180	0.18
„ 25	4	E.	+ 5.7	[+ 2.2]	− 5.48	δ Doradûs, β Aurigæ	5	57	41	52.80	0.177	0.16
„ 27	3	E.	+ 7.0	[+ 1.9]	− 6.71	δ Doradûs, β Aurigæ	6	51	41	59.24	0.132	0.14
„ 28	2	E.	+ 7.2	[+ 1.7]	[− 6.0]		6	22	42	2.52	0.139	0.17
Mar. 1	6	E.W.	+ 8.2	+ 1.6	− 5.23	θ Chamæl., γ Cancri, W.	8	40	42	7.90	0.205	0.20
„ 3	2	W.	+ 9.8	[+ 1.5]	− 8.15	θ Chamæleontis, σ Hydræ	7	51	42	16.31	0.178	0.16
„ 5	6	W.E.	+ 8.7	+ 1.4	− 8.17	δ Doradûs, β Aurigæ, W.	6	30	42	23.30	0.150	0.17
„ 7	4	E.	+ 6.6	[+ 1.9]	[− 7.2]		6	2	42	31.87	0.180	0.20
„ 8	4	E.	+ 5.9	[+ 2.1]	− 6.78	σ Octantis, S.P.	5	54	42	36 87	0.210	0.21
„ 9	6	E.	+ 6.7	[+ 2.3]	− 6.81	θ Chamæleontis, γ Cancri	6	44	42	42.27	0.217	0.21
„ 11	1	E.	+ 6.7	[+ 2.8]	[− 7.7]		7	21	42	51.46	0.189	0.16
„ 12	2	E.	+ 6.5	[+ 3.0]	[− 8.2]		7	10	42	55.05	0.151	
„ 12	5	E.W.	+ 5.8	+ 3.0	− 8.19	β Argûs, α Lyncis, E.	9	8	0	9.96		
„ 13	6	W.	+ 4.4	[+ 2.8]	− 7.37	θ Chamæleontis, γ Cancri	5	48	0	12.80	0.187	0.15
„ 14	6	W.	+ 3.8	[+ 2.7]	− 7.18	θ Chamæleontis, γ Cancri	5	49	0	16.89	0.170	0.16
„ 15	5	W.	+ 3.6	[+ 2.5]	− 8.30	σ Octantis, S.P.	5	20	0	20.51	0.154	0.17
„ 16	5	W.	+ 3.9	[+ 2.8]	− 7.23	σ Octantis, S.P.	5	15	0	25.02	0.189	0.19
„ 17	3	W.	+ 5.1	[+ 2.2]	− 8.25	σ Octantis, S.P.	5	11	0	29.39	0.183	0.18
„ 18	3	W.E.	+ 5.1	+ 2.0	− 8.08	σ Octantis, S.P., W.	7	4	0	33.93	0.175	0.18
„ 20	8	E.	+ 5.0	[+ 1.8]	− 8.75 − 9.82	ψ^5 Aurigæ, ζ Mensæ β Argûs, α Lyncis	7	22	0	43.18	0.190	0.25

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast or Slow on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1899.			"	"	"		H. M.	M S.	S.	S.
Mar. 21	4	E.	+ 4.2	[+ 1.7]	− 10.18	ψ^5 Aurigæ, ζ Mensæ	5 29	0 48.77	0.280	0.27
„ 22	4	E.	+ 5.1	[+ 1.6]	− 9.31	ψ^5 Aurigæ, ζ Mensæ	5 16	0 54.92	0.259	0.27
„ 23	5	E.	+ 4.4	[+ 1.5]	− 8.43	θ Chamæleontis, ϵ Hydræ	6 7	1 1.87	0.280	0.27
„ 26	5	E.W.	+ 3.7	+ 1.2	− 7.64 − 8.24	ζ^1 Cancri, θ Chamæl., E. β Argûs, θ Ursæ Maj., W.	7 14	1 19.22	0.237	
„ 26	1	W.	[+ 3.7]	[+ 1.2]	[− 7.9]		9 58	16 6.42		
„ 27	5	W.	+ 3.5	[+ 1.1]	− 8.83	ζ Mensæ, ζ Geminorum	5 32	16 2.93	0.178	0.20
„ 28	5	W.	+ 3.6	[+ 0.9]	− 7.93	θ Chamæl., γ Cancri	8 29	15 56.99	0.220	0.22
„ 29	7	W.E.	+ 2.4	+ 0.8	− 7.63	θ Chamæl., γ Cancri, W.	7 51	15 51.91	0.217	0.23
„ 30	5	E.	+ 1.0	[+ 0.9]	− 9.26	ι Ursæ Majoris, β Argûs	9 2	15 45.78	0.243	0.25
„ 31	2	E.	− 0.9	[+ 0.9]	[− 9.2]		6 19	15 40.50	0.248	0.25
April 5	4	E.W.	− 3.5	+ 1.2	− 8.26 − 9.02	β Cancri, θ Chamæl., E. ι Ursæ Maj., β Argûs, W.	8 3	15 11.41	0.239	0.22
„ 16	6	W.E.	− 3.3	+ 0.8	− 9.39	ζ Cham., 19 Leonis Minoris	9 58	14 26.62	0.168	0.14
„ 17	8	E.	− 3.0	[+ 0.9]	− 8.80 − 13.55	θ Chamæl., γ Cancri, 46 Leonis, Min. η Octant.	9 43	14 23.40	0.138	0.13
„ 22	6	E.W.	− 2.4	+ 1.6	− 9.89 − 11.65	β Argûs, θ Ursæ Maj., E. θ Ursæ Maj., ζ Cham., E.	9 51	14 9.65	0.114	0.11
„ 24	5	W.	− 1.8	[+ 1.6]	− 10.07	β Octantis, S.P., δ^2 Cham.	10 12	14 4.12	0.114	0.14
„ 26	2	W.	− 2.9	[+ 1.6]	[− 10.6]		10 27	13 56.30	0.162	0.17
May 3	3	W.	− 8.4	[+ 1.6]	[− 12.4]		12 0	13 25.27	0.183	0.21
„ 4	4	W.E.	− 9.3	+ 1.6	− 12.70	ζ Cham., 19 Leo. Min., W.	9 43	13 20.68	0.211	0.21
„ 5	5	E.	− 11.8	[+ 1.7]	− 13.76	θ Ursæ Majoris, ζ Cham.	9 6	13 15.02	0.242	0.25
„ 6	3	E.	− 12.5	[+ 1.7]	[− 14.1]		14 25	13 7.27	0.264	0.27
„ 7	5	E.	− 14.0	[+ 1.8]	− 14.38	ζ Chamæl., 19 Leo. Min.	9 51	13 1.96	0.273	0.25
„ 8	4	E.	− 15.9 + 12.8	[+ 1.8]	− 13.36	β Octantis, S.P., δ^2 Cham.	10 56	12 56.51	0.217	0.20

Instrumental Errors and Chronometer Errors and Rates—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Slow or Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1899.			"	"	"		H. M.	M. S.	S.	S.
May 9	3	E.	+ 14.0	[+ 1.9]	[− 12.6]		11 47	12 52.19	0.174	0.17
„ 10	3	E.	+ 14.1	[+ 1.9]	− 11.91	δ Octantis, θ Bootis	14 12	12 47.98	0.159	0.15
„ 12	6	E.W.	+ 12.7	+ 2.0	− 20.11	θ Chamæl., γ Cancri, E.	8 33	12 41.86	0.145	0.15
„ 13	3	W.	+ 12.9	[+ 1.9]	[− 15.8]		10 0	12 37.99	0.152	0.14
„ 14	5	W.	+ 12.6	[+ 1.8]	− 11.46	β Octantis, S.P., δ² Cham.	9 43	12 34.80	0.184	0.13
„ 15	2	W.	+ 12.1	[+ 1.8]	[− 13.0]		13 52	12 31.22	0.127	0.12
„ 16	7	W.	+ 11.5	[+ 1.7]	− 14.51	θ Apodis, d Bootis	12 53	12 28.62	0.118	0.12
„ 17	9	W.E.	+ 11.0	+ 1.6	− 13.99	η Octant., ν Ursæ Maj., W.	12 1	12 25.64	0.129	0.15
„ 18	8	E.	+ 10.7	[+ 1.5]	− 14.76	β Octantis, S.P., δ² Cham	10 14	12 21.75	0.175	0.21
„ 19	3	E.	+ 10.0	[+ 1.4]	[− 14.0]		8 57	12 16.19	0.245	0.23
„ 20	5	E.	+ 9.5	[+ 1.2]	− 13 22	β Octantis, S.P., δ² Cham.	9 35	12 10.96	0.212	0.21
„ 21	2	E.	+ 9.4	[+ 1.1]	[− 14.3]		10 6	12 5.91	0.206	0.22
„ 22	6	E.W.	+ 8.7	+ 1.0	− 15.29	η Octantis, ν Ursæ Maj., E.	11 22	12 0.10	0.280	0.26
„ 23	5	W.	+ 9.2	[+ 1.0]	− 11.69	β Octantis, S.P., δ² Cham.	10 51	11 53.24	0.292	0.28
„ 26	6	W.E.	+ 10.3	+ 1.0	− 11.89	β Oct., S.P., δ² Cham., W.	11 19	11 35.06	0.251	
June 6	4	E.	+ 11.3	[+ 1.9]	− 14.79	κ Octantis, η Bootis	13 55	0 13.21		
„ 10	6	E.W.	+ 10.9	+ 2.2	− 12.64	β Chamæl., β Hydri, E.	12 50	0 26.34	0.188	0.17
„ 11	3	W.	+ 10.3	[+ 2.1]	− 11.89	β Octantis, S.P., δ² Cham.	11 8	0 30.44	0.184	0.18
„ 28	8	W.E.	+ 10.0	+ 1.0	− 11.11 − 14.86	β Chamæl., β Hydri, W. κ Oct., η Ursæ Maj., E.	12 39	1 16.85	0.160	0.12
„ 23	3	E.	+ 10.0	[+ 1.0]	[− 13.0]		20 30	1 17.79	0.120	0.12
„ 24	6	E.	+ 10.5	[+ 1.0]	− 19.81	α Canum Venati., δ Muscæ	12 17	1 19.88	0.132	0.14
„ 28	8	E.	+ 10.6	[+ 0.8]	− 16.69	κ Octantis, η Ursæ Majoris	13 12	1 35.34	0.160	0.17
„ 29	6	E.W.	+ 12.0	+ 0.8	− 13.62	κ Octant., η Ursæ Maj. W.	12 30	1 39.29	0.170	0.17
July 2	5	W.	+ 13.3	[+ 0.8]	− 13.09	κ Octantis, η Ursæ Majoris	14 54	1 51.84	0.169	0.19
„ 8	4	W.	+ 12.8	[+ 0.8]	− 10.68	β Chamæleontis. β Hydri	12 41	1 56.13	0.197	0.20

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1899.			"	"	"		H. M.	M. S.	S.	S.
July 4	5	W.	+ 12.6 − 0.1	[+ 0.8]	− 11.56	β Chamæleontis, β Hydri	13 17	2 1.00	0.198	0.18
„ 5	6	W.E.	− 1.8	+ 0.8	− 11.54	β Chamæl., β Hydri, W.	13 15	2 4.64	0.152	0.14
„ 6	8	E.	− 1.8	[+ 1.0]	[− 11.7]		15 7	2 7.81	0.123	0.12
„ 13	8	E.W.	− 0.9	+ 2.0	− 14.44 − 10.73	κ Oct., η Ursæ Maj., E. θ Apodis, d Bootis, W.	13 27	2 24.39	0.100	0.10
„ 16	8	W.	− 0.8	[+ 2.1]	− 12.82 − 13.02	θ Apodis, d Bootis α Tri. Aust., κ Ophiuchi	15 8	2 31.33	0.094	0.09
„ 17	5	W.	− 0.5	[+ 2.1]	− 13.47	ρ Bootis, α Apodis	13 33	2 33.46	0.095	0.11
„ 18	6	W.	− 0.4	[+ 2.1]	− 12.52	δ Bootis, ρ Octantis	14 2	2 36.32	0.117	0.12
„ 21	7	W.E.	+ 0.1	+ 2.2	− 12.14 − 12.26	ρ Bootis, α Apodis, W. δ Bootis, ρ Octantis, E.	14 49	2 44.83	0.117	0.12
„ 24	6	E.	+ 0.2	[+ 2.0]	− 12.14	δ Bootis, ρ Octantis	14 33	2 53.87	0.126	0.12
„ 25	8	E.	0.0	[+ 2.0]	[− 12.8]		18 40	2 57.35	0.124	0.11
„ 27	6	E.	+ 0.6	[+ 1.9]	− 13.99	η Ursæ Majoris, θ Apodis	14 35	3 1.31	0.090	0.09
„ 28	6	E.W.	+ 0.2	+ 1.8	− 14.36	η Ursæ Maj., θ Apodis, E.	15 33	3 3.40	0.084	0.08
„ 29	5	W.	+ 0.9	[+ 1.7]	− 12.82	ρ Octantis, α Cor. Borealis	15 49	3 5.38	0.081	0.08
Aug. 1	3	W.	+ 0.8	[+ 1.6]	− 13.81	ϵ Cor. Borealis, δ^1 Apodis	15 46	3 11.73	0.088	0.07
„ 3	5	W.	+ 1.7	[+ 1.5]	− 13.58	ϵ Cor. Borealis, δ^1 Apodis	15 57	3 14.74	0.062	0.06
„ 5	6	W.E.	+ 2.7	+ 1.4	− 11.49	α Apodis, ϵ Bootis, W.	16 5	3 17.39	0.055	0.08
„ 6	3	E.	+ 3.6	[+ 1.4]	[− 13.1]		19 28	3 20.00	0.096	0.10
„ 7	4	E.	+ 5.1	[+ 1.4]	− 14.78	γ Apodis, β Herculis	16 33	3 22.14	0.101	0.13
„ 8	5	E.	+ 5·1	[+ 1.4]	− 13.27	δ Bootis, ρ Octantis	15 41	3 25.84	0.160	0.17
„ 9	6	E.	+ 5.1	[+ 1.4]	− 11.05	δ Bootis, ρ Octantis	15 46	3 30.17	0.180	0.17
„ 10	1	E.	+ 5.5	[+ 1.4]	− 10.07	δ^1 Apodis, ζ Ophiuchi	16 35	3 33.94	0.152	0.14
„ 12	3	E.	+ 5.8	[+ 1.4]	[− 11.6]		17 14	3 38.94	0.108	0.09

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
1899. Aug. 15	6	E.W.	+ 12.3	+ 1.4	− 12.41	α Tri. Aust., κ Ophiuchi, E.	17 10	3 44.75	0.081	0.07
„ 16	4	W.	+ 13.4 + 0.9	[+ 1.4]	− 14.11	γ Apodis, β Herculis	16 41	3 46.44	0.072	0.07
„ 25	7	W.E.	− 265.0 + 7.5	+ 1.2	+ 5.17	λ¹ Octantis, π² Cygni, E.	21 17	4 4.78	0.083	0.07
„ 26	4	E.	+ 6.4	[+ 1.2]	+ 5.69	δ Cygni, ε Pavonis	17 56	4 6.08	0.063	0.07
„ 27	5	E.	+ 7.0	[+ 1.3]	+ 0.44	α Tri. Aust , *d* Herculis	17 0	4 7.67	0.069	0.08
„ 28	2	E.	+ 6.0	[+ 1.3]	[+ 0.5]		17 27	4 9.80	0.087	0.08
„ 29	5	E.	+ 6.1	[+ 1.4]	+ 0.55	α Tri. Aust., *d* Herculis	17 11	4 11.40	0.067	0.06
„ 30	5	E.W.	+ 6.0	+ 1.4	− 1.97	γ Apodis, β Herculis, E.	16 56	4 12.78	0.058	0.08
„ 31	2	W.	+ 7.1	[+ 1.3]	[− 1.0]		18 16	4 15.25	0.098	0.10
Sept. 1	5	W.	+ 7.8	[+ 1.3]	+ 0.03	γ Apodis, β Herculis	16 47	4 17.75	0.111	0.10
„ 2	5	W.	+ 7.9	[+ 1.2]	+ 1.27	α Tri. Aust., *d* Herculis	16 51	4 19.93	0.091	0.09
„ 3	3	W.	+ 7.9	[+ 1.1]	[+ 0.5]		16 54	4 21.92	0.083	0.08
„ 4	6	W.	+ 9.2	[+ 1.1]	− 0.33	α Tri. Aust., *d* Herculis	16 55	4 23.87	0.081	0.11
„ 5	8	W.E.	+ 9.2	+ 1.0	+ 1.16	α Tri. Aust., *d* Herculis, W.	17 5	4 27.03	0.131	0.11
„ 6	4	E.	+ 9.5	[+ 1.1]	+ 2.06	*b* Ophiuchi, β Draconis	17 27	4 29.38	0 096	0.10
„ 7	5	E.	+ 9.8	[+ 1.2]	+ 1.05	α Tri. Aust., *d* Herculis	17 12	4 32.01	0.111	0.11
„ 8	3	E.	+ 11.1	[+ 1.2]	[+ 1.1]		17 7	4 34.60	0.108	0.11
„ 10	7	E.W.	+ 12.5	+ 1.4	[+ 1.2]		17 38	4 40.48	0.121	0.12
„ 11	2	W.	+ 12.2	[+ 1.2]	[+ 1.8]		17 16	4 43.17	0.114	0.12
„ 12	7	W.E.	+ 13.6	+ 1.0	+ 1.33 + 1.84	σ Octantis, W. δ Cygni, ε Pavonis, E.	18 23	4 46.24	0.122	0.11
„ 13	4	E.	+ 13.1	[+ 1.0]	+ 0.88	σ Octantis	19 8	4 48.61	0.096	0.12
„ 14	10	E.	+ 14.0	[+ 1.1]	+ 2.61	λ¹ Octantis, π² Cygni	20 58	4 52.26	0.141	0.13
„ 15	8	E.	+ 13.7	[+ 1.1]	+ 0.46	σ Octantis	18 45	4 55.03	0.127	0.12

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1899.			"	"	"		H. M.	M. S.	S.	S.
Sept. 18	8	E.W.	+ 15.9 + 5.4	+ 1.2	+ 0.44	σ Octantis, W.	18 51	5 3.04	0.111	0.13
„ 20	6	W.	+ 3.5	[+ 1.2]	+ 0.24 + 1.30	σ Octantis δ Cygni, ϵ Pavonis	19 20	5 9.85	0.140	0.13
„ 22	4	W.	+ 4.3	[+ 1.2]	[+ 1.9]		20 46	5 16.04	0.125	0.14
„ 23	6	W.	+ 6.2	[+ 1.2]	+ 2.46	λ^1 Octantis, 16 Pegasi	21 26	5 19.66	0.147	0.15
„ 29	6	W.E.	+ 7.5	+ 1.2	+ 2.78	λ^1 Octantis, π^2 Cygni, W.	21 55	5 47.35	0.192	0.16
Oct. 1	5	E.	+ 9.2	[+ 1.7]	− 2.17	σ Octantis	19 16	5 54.24	0.152	0.21
„ 2	4	E.	+ 10.6	[+ 1.9]	[− 1.6]		19 29	5 59.94	0.235	0.22
„ 5	6	E.W.	+ 13.0	+ 2.6	+ 0.84 − 0.49	δ Cygni, ϵ Pavonis, E. λ^1 Oct., 16 Pegasi, W.	21 31	6 13.86	0.188	0.18
„ 7	7	W.E.	+ 14.0	+ 2.0	− 0.87	λ^1 Octantis, π^2 Cygni, W.	20 49	6 21.92	0.170	0.19
„ 8	8	E.	+ 15.2 − 15.2	[+ 1.9]	− 0.61	λ^1 Octantis, π^2 Cygni	21 31	6 27.03	0.207	0.22
„ 9	8	E.	− 12.4	[+ 1.9]	+ 0.49	λ^1 Octantis, 16 Pegasi	20 53	6 32.35	0.228	0.22
„ 10	4	E.	− 12.0	[+ 1.8]	[+ 0.1]		21 48	6 37.80	0.219	0.22
„ 11	8	E.	− 11.5	[+ 1.8]	− 0.35	β Chamæleontis, β Hydri	23 18	6 43.31	0.216	0.25
„ 12	10	E.	− 13.1	[+ 1.7]	− 2.07	β Chamæleontis, β Hydri	22 20	6 49.86	0.284	0.27
„ 13	8	E.	− 8.7	[+ 1.7]	+ 0.64	λ^1 Octantis, π^2 Cygni ...	20 54	6 55.74	0.261	0.22
„ 14	4	E.W.	− 6.6	+ 1.6	− 0.56	1 Pegasi, λ^1 Octantis, E.	22 2	7 0.29	0.181	0.17
„ 15	6	W.	− 5.5	[+ 1.7]	− 1.24	π^2 Pegasi, υ Octantis	20 50	7 3.91	0.159	0.17
„ 17	4	W.	− 7.4	[+ 1.8]	[− 1.8]		23 2	7 13.29	0.187	0.22
„ 18	6	W.	− 6.7	[+ 1.8]	− 2.06	λ^1 Octantis, 16 Pegasi	21 19	7 18.58	0.237	0.23
„ 22	6	W.E.	− 5.6	+ 2.0	− 2.22	λ^1 Octantis, π^2 Cygni, E.	21 4	7 36.89	0.191	0.17
„ 23	4	E.	− 3.1	[+ 1.9]	− 3.23	β Octantis, λ Pegasi	22 52	7 41.17	0.166	0.16
„ 25	3	E.	− 3.0	[+ 1.6]	[− 3.8]		22 33	7 48.45	0.153	0.15
„ 30	5	E.W.	− 0.1	+ 1.0	− 5.04	λ^1 Octantis, π^2 Cygni, E.	22 13	8 7.31	0.158	0.15

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
			"	"	"		H. M.	M. S.	S.	S.
1899.										
Oct. 31	5	W.	+ 1.2	[+ 1.1]	− 5.98	λ^1 Octantis, π^2 Cygni	21 52	8 10.98	0.153	0.15
Nov. 1	4	W.	+ 2.0	[+ 1.1]	− 7.27	1 Pegasi, λ^1 Octantis	22 2	8 14.41	0.144	0.14
„ 7	6	W.E.	+ 12.7	+ 1.4	− 7.81	π^2 Pegasi, υ Octantis, W.	22 51	8 33.14	0.129	0.11
„ 8	1	E.	+ 13.8	[+ 1.3]	[− 7.8]		0 12	8 35.85	0.107	0.12
„ 9	9	E.	+ 15.8	[+ 1.3]	− 7.81 − 7.79	π^2 Pegasi, υ Octantis β Octantis, o Androm.	23 51	8 39.11	0.138	0.17
„ 10	6	E.	+ 17.8	[+ 1.2]	− 7.85	π^2 Pegasi, υ Octantis	22 25	8 43.73	0.205	0.18
„ 11	5	E.	+ 20.2 − 16.4	[+ 1.2]	− 7.33	π^2 Pegasi, υ Octantis	22 32	8 47.25	0.146	0.15
„ 14	4	E.	− 12.0	[+ 1.0]	− 5.72	γ^1 Octantis, α Androm.	0 20	8 58.39	0.151	0.13
„ 15	2	E.	− 10.4	[+ 0.9]	[− 6.9]		0 44	9 1.52	0.128	0.13
„ 17	6	E.W.	− 9.1	+ 0.8	− 9.24	β Octantis, λ Pegasi, E.	23 3	9 7.35	0.126	0.18
„ 18	8	W.	− 7.7	[+ 1.3]	− 8.95	β Octantis, λ Pegasi	0 3	9 10.59	0.130	0.17
„ 19	5	W.	− 6.2	[+ 1.9]	− 8.71	β Octantis, λ Pegasi	23 8	9 15.57	0.216	0.22
„ 20	5	W.	− 5.1	[+ 2.4]	− 8.93	λ Andromedæ, γ^1 Octantis	23 27	9 20.92	0.220	0.23
„ 21	4	W.	− 2.6	[+ 2.9]	[− 9.5]		0 21	9 26.90	0.240	0.22
„ 23	6	W.E.	+ 2.2	+ 4.0	− 10.77	λ Androm., γ^1 Octantis, W.	23 57	9 35.70	0.185	0.18
„ 24	4	E.	+ 7.4	[+ 3.5]	− 2.38	λ Andromedæ, γ^1 Octantis	23 43	9 40.07	0.184	0.21
„ 25	9	E.	+ 7.9	[+ 3.0]	− 4.75	λ Andromedæ, γ^1 Octantis	0 26	9 45.90	0.236	0.20
„ 26	4	E.	+ 9.3	[+ 2.4]	− 5.93	λ Andromedæ, γ^1 Octantis	23 22	9 49.64	0.168	0.17
„ 27	5	E.	+ 11.2	[+ 1.9]	− 8.10	λ Andromedæ, γ^1 Octantis	0 4	9 53.82	0.169	0.17
„ 28	6	E.W.	+ 14.6	+ 1.4	− 6.40	γ^1 Octantis, 22 Androm., E.	0 54	9 57.81	0.161	0.16
Dec. 1	4	W.	+ 18.4 − 15.1	[+ 1.2]	[− 7.0]		1 24	10 10.41	0.174	0.17
„ 5	4	W.	− 8.2	[+ 1.0]	[− 7.9]		1 16	10 27.18	0.175	0.15
„ 8	6	W.E.	− 3.0	+ 0.8	− 8.49	β Hydri, π Androm., W.	1 18	10 36.66	0.132	0.12
„ 12	4	E.	+ 4.0	[+ 0.9]	[− 9.3]		1 14	10 47.70	0.115	0.13

Instrumental Errors and Chronometer Errors and Rates.—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp, E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1899.			"	"	"		H. M.	M. S.	S.	S.
Dec. 14	6	E.	+ 4.4	[+ 1.0]	− 9.66	β Persei, ι Hydri	1 52	10 54.50	0.140	0.19
„ 16	7	E.W.	+ 9.9	+ 1.0	− 9.31	β Androm., κ Tucanæ, E.	1 32	11 5.94	0.240	0.22
„ 17	6	W.	+ 12.2	[+ 1.1]	− 7.09 − 9.58	β Hydri, μ Andromedæ β Androm., κ Tucanæ	1 15	11 11.01	0.214	0.21
„ 22	5	W.	+ 24.0 − 12 2	[+ 1.9]	− 7.50	γ Hydri, A¹ Tauri	2 48	11 32.94	0.180	0.12
„ 23	7	W.E.	− 7.2	+ 2.0	− 7.53	γ Tauri, δ Mensæ, E.	2 19	11 35.41	0.105	0.12
„ 25	6	E.	− 3.7	[+ 1.6]	− 7.14	γ Hydri, A¹ Tauri	2 26	11 42.74	0.152	0.13
„ 26	6	E.	+ 1.8	[+ 1.5]	− 7 50	η Tauri, γ Hydri	2 12	11 45.63	0.122	0.13
„ 29	6	E.	+ 10.0	[+ 0.9]	− 6.92 − 5.24	γ Trianguli, δ Hydri μ Hydri, θ Persei	3 3	11 56.75	0.153	0.17
„ 30	6	E.	+ 12.6	[+ 0.8]	− 6.53 − 3.58	γ Trianguli, δ Hydri μ Hydri, σ Arietis	2 33	12 0.83	0.174	
„ 31	—	E.	+ 14.9	+ 0.6						
„ 31	—	W.	+ 15.1							

NOTES.

1899

February 1st—The eastern pivot was raised during the observations.

March 12th—The chronometer, which had run down, was wound and re-started.

March 18th—Transits could not be observed with the clamp east.

March 26th—The chronometer, which was omitted to be wound on the 25th, ran down this evening. It was wound and re-started as soon as the omission was detected, but the error turned out to be about 16 minutes slow.

May 8th—The eastern pivot was lowered during the observations.

June 6th—The chronometer, which was omitted to be wound on the 3rd, was wound and re-started this evening.

July 4th. August 16th—The eastern pivot was raised before the observations.

August 25th—The level error just previous to the transits was—265.0″. This great rise of the eastern pivot was doubtless due to persistent rainy weather. From 9h. a.m. on the 17th to 9h. a.m. on the 25th, 5.039 inches of rain were recorded. The pivot was at once lowered. It is probable that the azimuth was changed during the adjustment.

September 18th, October 8th, November 11th—The eastern pivot was raised during the observations.

November 24th—It is probable that in reversing the instrument on the 23rd the azimuth was changed.

December 1st—The eastern pivot was raised during the observations.

December 22nd—The eastern pivot was raised before the observations.

December 31—Clouds prevented transit observations. The level and collimation errors, however, were determined.

Extra-Meridian Work.

OCCULTATIONS OF STARS BY THE MOON:—Seventy-six phases of occultations have been observed with the eight-inch, and two with the four-and-a-half-inch equatorial. Of these sixty were disappearances at the moon's dark limb, and twelve and six disappearances and reappearances respectively at the moon's eclipsed limb on June 23. I am indebted to Mr. C. J. Merfield F.R.A.S., for an extensive list of occultations during the eclipse. Most of the stars were taken from the Cape Photographic Durchmusterung, and were very faint. Last year's work brings the total number of occultation phases observed here since the year 1863 to 1101, of which those observed during the years 1864-1876 have already been reduced for longitude by Drs. Auwers and Clemens, with highly satisfactory results. The observations for 1899 have been sent to the *Astronomische Nachrichten.*

PLANET OBSERVATIONS. — The following planets were observed with the filar-micrometer on the eight-inch equatorial:—

Planets.	Nights of Observation.	Comparisons.	Comparison Stars.
(4) Vesta	7	81	1
(7) Iris	30	380	17
(17) Thetis	16	204	3
Neptune ...	6	80	1

The observations of Iris were undertaken expressly for the investigation by Dr. J. Riem, of Berlin, of new tables for this planet. The results for the minor planets have been kindly compared by Mr. C. J. Merfield, with the ephemerides in the *Nautical Almanac* and the *Astronomische Jahrbuch*, and found to be consistent. I am also indebted to the same gentleman for the definitive co-ordinates of 114 (o) Tauri compared with Neptune, which are derived from numerous catalogues.

COMET OBSERVATIONS. — The following Comets were observed with the square bar-micrometer:—

Comets.	Nights of Observation.	Comparisons.	Comparison Stars.
1898. VII. (Coddington)	23	152	33
1899. I. (Swift)	28	233	35
1899. IV. (Tempel$_2$, 1873)	43	413	51

The observations of Comet 1898 VII. were a continuation of a series obtained during the latter half of 1898. The total number of nights on which the Comet was observed in 1898 and 1899 was 103, the number of comparisons was 764 and of the comparison stars, 138. The eight-inch equatorial was employed throughout. A Kiel cable message was received from the Melbourne Observatory on March 6, announcing the appearance of Comet I. 1899, but giving the north polar distance for March 4.6356 G.M.T. as 52″. As there was obviously something wrong in this co-ordinate I requested the telegraph authorities to repeat the message; but, notwithstanding my repeated application for a repetition, it was disregarded. A letter, however, from Mr. Russell appeared in the *Sydney Morning Herald* of the 7th, giving what turned out to be the Comet's correct north polar distance, and I was thereby enabled to observe the Comet on the evening of the same day. A complaint being forwarded to the central telegraph authority, a promise was kindly given that there should be no cause for a repetition of it. It is neither the first nor the second time that I have had trouble over Comet messages. That it is quite expedient that such messages should reach Windsor punctually and accurately is shown by the following statement of the number of nights for which Comet positions were determined and published by the Australian Observatories during the twenty years 1880-1899:—Government Observatory, Sydney, 95 nights; Government Observatory, Melbourne, 174 nights; Government Observatory, Adelaide, 20 nights; and the Windsor Observatory, 700 nights. Comet 1899 I. was followed till the close of March, when it was no longer possible to find comparison stars in the twilight. The eight-inch equatorial was employed from March 7 to 23 inclusive, subsequently, and to the close of the month the four-and-a-half-inch instrument was availed of, as the Comet passed behind the library roof during twilight. The latest observations recorded before conjunction with the sun are, I believe, those made at Windsor. After the conjunction the Comet was well observed in the northern hemisphere, but by June 28 was again well placed for local work It was, however, faint and diffused. The observations closed here on July 13. I am greatly indebted to Mr. Merfield for

ephemerides of the two Comets thus observed. Towards the close of June, I received a letter from Mons. L. Schulhof, of Paris, enclosing an early ephemeris for the return of Tempel's periodical Comet II. of 1873, and asking me to observe this interesting object as long as possible. A series of observations was accordingly made with the square bar-micrometer on the eight-inch equatorial, extending from July 2 to October 7. The Comet was too faint to be followed after the latter date.

SUNDRY OBSERVATIONS:—In addition to the work already recorded, a series of observations of phenomena of Jupiter's satellites was also made, but I regret that in consequence of other engagements I have been unable to follow satisfactorily the variations of the light of the remarkable southern star, *R. Carinæ*.

Meteorological Observations.

In accordance with the programme in the Report for 1898, meteorological observations were taken here during the year 1899. The instruments and their exposure are fully described in the introduction to the *Results of Meteorological Observations* for 1891-97. The following are the results:—

1899.	Temperatures.				Rainfall.			
	Highest Shade.	Lowest Shade.	Highest in Sun, Black Bulb in Vacuo.	Lowest Radiation on Grass.	Gauge 6.8 feet above Ground.	Gauge 22.0 feet above Ground.	Greatest Daily Fall by Lower Gauge.	Date 9h. a.m.
	°	°	°	°	Inches.	Inches.	Inches.	
January ...	114.3	49.2	161.3	43.0	1.417	1.386	0.970	19
February ...	103.9	44.8	163.5	41.3	0.169	0.152	0.090	20
March	105.2	45.9	147.4	39.9	2.026	1.911	0.774	12
April	101.0	45.1	144.0	38.7	2.192	2.030	0.825	5
May	84.4	29.2	127.5	23.8	0.959	0.941	0.463	30
June	74.3	30.4	119.0	28.6	2.878	2.703	1.218	28
July	73.8	28.3	120.7	23.8	2.025	1.958	0.665	11
August	84.0	30 5	128.5	26.0	3.672	3.106	1.916	23
September ...	92.2	39 5	139.2	33 8	2.017	1.881	0.987	28
October... ...	94 4	33 5	143.7	28.2	1.548	1.467	0.682	21
November ...	107.3	45.8	161.1	40.3	2.920	2.785	1.063	5
December ...	116.3	50.2	164.0	43.7	0.899	0.840	0.419	14
Year ...	116.3	28.3	164.0	23.8	27.722	26.160	1.916	Aug 23

The indications of the shade thermometers have been corrected as described on page 15 of the Report for 1898. At the close of 1897, when I discontinued the regular meteorological

work which I had carried on for so many years, I pointed out to the superintendent of the work at the Hawkesbury Agricultural College that the temperature observations made there could not be compared with the results obtained here, because the mode of exposure of the thermometers at the two stations was different. At Windsor the old Greenwich stand was employed ever since 1862, while at the College the thermometers are enclosed in a Stevenson's stand. I suggested that a Greenwich stand should be placed beside the Stevenson's stand and a series of comparisons be made with both modes of exposure in order to get an equation between the Windsor and College results. I am not aware if this suggestion has been carried out; if not, I will make the necessary comparisons at my Observatory.

Publications.

With the exception of the first three papers, which were omitted to be noticed in former Reports, the following have appeared in scientific journals since the publication of the last Report :—

COMPARISONS OF THE VARIABLE STAR R. CARINÆ, 1896, December 23, to 1897, August 31.—*Journal of the British Astronomical Association*, Vol. VIII., p. 85.

PROBABLE OCCULTATION OF 41 LIBRÆ BY URANUS, 1897, September 8, *The Same,* Vol. VIII., p. 86.

DISCOVERY OF ENCKE'S COMET, 1898, June 11.—*The Observatory,* Vol. XXI., p. 315.

FURTHER EQUATORIAL COMPARISONS OF COMET CODDINGTON (c 1898), 1898, October 31, to 1899, February 15.—*Royal Astronomical Society's Monthly Notices*, Vol. LIX., p. 388.

EQUATORIAL COMPARISONS OF JUPITER, URANUS, AND NEPTUNE, WITH CERTAIN STARS IN NEWCOMB'S STANDARD CATALOGUE.—*R.A.S. Monthly Notices*, Vol. LIX., p. 543.

STAR OCCULTATIONS BY THE MOON OBSERVED IN 1898. —*Astronomische Nachrichten,* Band CXLIX., p. 381.

EQUATORIAL COMPARISONS OF COMETS, 1898, VII. (CODDINGTON), 1899, March 3, AND 1899, I. (SWIFT), 1899, March 7 to 31.—*Ast. Nach.*, Band CL., p. 45.

EQUATORIAL COMPARISONS OF (17) THETIS, 1899, May 6 to 23, of COMET 1899, I. (SWIFT), 1899, June 28 to July 13, AND OF COMET 1899, IV. (TEMPEL$_2$, 1873), 1899, July 2 to October 7.—*Ast. Nach.*, CLI., p. 277.

Observations Recently Utilised.

The two observations, 1889, Oct. 25, 28 of the periodical Comet 1889, V. (Brooks), published in *Ast. Nach.*, Band CXXIII. p. 409, have been employed in Dr. J. Bauschinger's investigation of the definitive orbit of this Comet. See *Neue Annalen der Münchener Sternwarte*, Band III., p. 25. Although the Comet was exceedingly faint, the positions have turned out good.

The observations of Comets 1898, VII., and 1899, I., have been extensively used by Mr. C. J. Merfield, F.R.A.S., in his determination of the orbits of these comets. See *Ast. Nach.*, Band CXLVII., p. 333, Band CXLIX., p. 397, Band CLI., p. 23, and *Journal of the Royal Society of New South Wales*, Vol. XXXIII., p. 177.

The Library.

As will be seen by the accompanying list of donations for 1899, the library has been increased by contributions from 55 public institutions and 23 private individuals. The proprietor tenders his best thanks to the various donors, to each of whom a copy of this Report will, in accordance with custom, be sent.

Conclusion.

All the observations, both astronomical and meteorological, have been made by the author, and nearly all the reductions have been worked out by him. During the current year it is his intention to devote himself mainly to the observation of double stars, the reductions of which are comparatively easy. At his age he finds the reduction of planet and comet work too great a burden when added to the work of observing and recording. Were he able to secure the occasional services of two competent computers, the case would be different, for he would be able to continue the work of planet and comet observation and the superintendence of the reductions. During the past year two professed computers offered their services, but it was found that their work was rather a drawback than an assistance. In the northern hemisphere it is probable that this difficulty is not widely experienced.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1899.

[NOTE.—The names of the Donors are printed in italics.]

Results of Rain, River, and Evaporation Observations in New South Wales in 1897, with maps and diagrams ; pp. lxiii., and 220.

Current Papers, No. 3, with maps, by H. C. Russell, F.R.S., &c.; pp. 12.

The Government Observatory, Sydney.

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory and Other Places in Victoria, July 1 to December 31, 1897; pp. 42.

The Same, January 1 to June 30, 1898; pp. 42.

Thirty-third Report of the Melbourne Observatory, July 1, 1898, to February 28, 1899; pp. 8.

The Government Observatory, Melbourne.

Meteorological Observations at Adelaide Observatory, and Other Places in South Australia, during 1896, with map.

The Government Observatory, Adelaide.

Meteorological Observations at Perth Observatory and Other Places in Western Australia, during 1897 ; with maps, pp. 50.

The same, during 1898 ; with maps, pp. 84.

Report on the Latitude and Longitude of the Perth Observatory, W.A. ; pp. 3.

The Government Observatory, Perth, W.A.

The Surveyor for 1899. Twelve monthly numbers complete.

List of Licensed Surveyors in New South Wales, 1899; pp. 16.

The Institution of Surveyors, New South Wales.

Proceedings and Transactions of the Queensland Branch of the Royal Geographical Society of Australasia. Vol. XIII., 1897–98; pp. 87.

The same. Vol. XIV., 1898–99; pp. 72.

The Queensland Branch of the Royal Geographical Soc. of Aust.

Weekly Weather Reports, 1898, November 26, to 1899, November 18; complete, with title and preface for 1898.

Monthly Summaries of Observations at Stations in the Daily and Weekly Weather Reports, 1898, August to 1899, July; complete.

Quarterly Summaries of the Weekly Weather Report, 1899, January to March, April to June, July to September.

Summary of the Weekly Weather Report, 1898, Vol. XV., Appendix I.

Weekly Weather Report, Vol. XV., Appendix II.

Meteorological Observations at Stations of the Second Order for 1895; pp. 184.

Hourly Means of the Self-recording Instruments at the Five Observatories under the Meteorological Council, 1895; pp. xiii., 239 with Appendix, pp. 83.

Report of the Meteorological Council for year ending 1898, March 31; pp. 139.

Indian Meteorological Memoirs, Vol. X., Parts I. and II.; pp. 352.

The Meteorological Office, London.

Twenty-fourth Annual Report, 1898–99, of the Oxford University Observatory, pp. 8. *The Oxford University Observatory.*

Catalogue of 14,464 Stars, between Declinations + 24° 15′ and + 30° 57′, for 1875, from observations at the University Observatory. Cambridge, Eng.; pp. (10) and 308.

The Cambridge University Observatory.

Annals of the Cape of Good Hope Observatory, Vol. I., Part I. Observations of Comets, 1880-94; pp. ix., 39.

The Astronomer Royal, England.

Astronomical and Meteorological Observations at Radcliffe Observatory, Oxford, 1890 and 1891. *The Radcliffe Observatory, Oxford.*

Precession Tables, adapted to Newcomb's Precession Constant and reduced to 1910.0; pp. iv., 85. *The Nautical Almanac Office.*

Report of the Liverpool Observatory, Bidston, Birkenhead and Meteorological results for 1898; pp. 41. *The Liverpool Observatory.*

Report of the Kew Observatory for 1898; pp. 38.

The Kew Observatory.

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, with Report for 1898; pp. 80.

Stonyhurst College Observatory.

Report and Results of Meteorological Observations for 1898 at the Fernley Observatory, Southport; pp. 27.

The Fernley Observatory, Southport.

Variable Star Notes, Rousdon Observatory, Devon. No. 4, pp. 17, and No. 5, pp. 16, with diagrams.

Meteorological Observations. Vol. XV. for 1898, pp. 40.

The Rousdon Observatory, Devon.

Astronomical Observations and Researches at Dunsink Observatory, Dublin; Part 8. *Observatory of Trinity College, Dublin.*

Report of Her Majesty's Astronomer at the Cape of Good Hope for 1898; pp. 18.

Independent Day-Numbers for 1901, as used at the Royal Observatory, Cape of Good Hope; pp. 14.

The Royal Observatory, Cape of Good Hope.

Monthly Weather Review, 1898, September, to 1899, August, complete.

Toronto General Meteorological Register for 1898 ; pp. 11.

Report of the Meteorological Service of Canada for 1896 ; 2 Vols. pp. 796.

The Meteorological Office, Toronto.

Report of the Government Astronomer, Colony of Natal, for 1898 ; pp. 6. and U 61.

The Natal Observatory.

Report of the Madras Observatory for 1898-99 ; pp. 8, with diagram.

The Madras Observatory.

Observations and Researches at Hongkong Observatory 1898; pp. 20 and (125).

The Hongkong Observatory.

Second Washington Catalogue of Stars, Epoch 1875·0, from Observations 1866 to 1891 ; pp. lxii, 287.

Report of the U.S. Naval Observatory for year ended 1898, June 30 ; pp. 19.

The U.S. Naval Observatory, Washington.

The American Ephemeris and Nautical Almanac for 1901, 1st Ed.; pp. 631.

The same for 1902; 1st Ed., pp. 587.

Office of the American Ephemeris.

Fifty-third Report of Harvard College Observatory for the year ending 1898, September 30 ; pp. 14.

Annals of Harvard College Observatory, Vol. XXIII., Part III. Discussion of Observations of Meridian Photometer, 1882-88 ; pp. 137 to 245.

Harvard College Observatory.

Publication of the Cincinnati Observatory, No. 14. Catalogue of 2030 Stars for 1895 ; pp. 114.

The Cincinnati Observatory.

Rutherfurd Photographic Measures. Nos. 12, 13, 14, by H. S. Davis, Ph. D. ; pp. 54 to 187.

The Præsepe Group. Measurement and Reduction of the Rutherfurd Photographs, by J. Schlesinger ; pp. 185 to 286.

The Columbia University Observatory.

Bulletin No. 4 of the Yerkes Observatory.—Dedication Address.

Bulletin No. 5.—Proceedings of the Conference at the Observatory, 1897, October 18-21.

Bulletin No. 6.—Parallax of the Andromeda Nebula ; pp. 3.

Bulletin No. 7.—Spectra of Stars of Secchi's 4th Type ; pp. 2, with plate.

Bulletin No. 8.—Opportunities for Students at the Yerkes Observatory ; pp. 2.

Bulletin No. 9.—Comparison of Stellar Spectra of the 3rd and 4th Types ; pp. 2, with plates.

Bulletin No. 10.—Period and Elongation Distance of the Fifth Satellite of Jupiter ; pp. 3.

Bulletin No. 11.—Heat Radiation of the Stars ; pp. 3.

The Yerkes Observatory, Chicago.

Report of the Yale University Observatory for 1898-99 ; pp. 21.
Yale University Observatory.

The Field for Chemical Improvement in the Manufacture of Sugar. By W. Skaife ; pp. 12. *The Franklin Institute, Philadelphia.*

Report of the Harvard Astrophysical Conference, 1898, August.
The Observatory, Philadelphia, U.S.A.

Sunspot Drawings at the Georgetown College Observatory, in 1850, September 20 to November 6, by Father B. Sestini, S.J. 44 plates. 2 copies. *The Georgetown College Observatory, U.S.A,*

Proceedings of the American Philosophical Society, Philadelphia. Vols. for 1897, January, May, December; 1898, July, December; 1899, January. *The American Philosophical Society, Philadelphia.*

Rapport Annuel de l'Observatoire de Paris pour 1898 ; pp. 31.
The Paris Observatory.

Annales de l'Observatoire de Nice. Tome I.; pp. xxxviii., 312, and Atlas.
The Nice Observatory.

Annales de l'Alliance Scientifique Universelle, 1899. Nos. 121, 122, 123.

Bibliothèque Internationale. Fascicule Publie, par M. P. Pallary; pp 88.
L'Alliance Scientifique Universelle.

Untersuchungen über den periodischen Kometen 1889, V. 1896, VI. (Brooks); von J. Bauschinger. 2 Theil; pp. 52.

Planeten Elemente nebst Angaben über die Oppositionen und Oppositions-Ephemeriden kleiner Planeten für 1899; pp. 379-470.

Genäherte Oppositions-Ephemeriden von 52 kleinen Planeten für 1899, Januar bis August; pp. 17.

Genäherte Oppositions-Ephemeriden von 32 kleinen Planeten für 1899, Juli bis December, pp. 12.
Koniglichen Ast. Recheninstituts, Berlin.

Neue Annalen der K. Sternwarte in München. Band III., mit 9 tafeln; pp. 342. *The Munich Observatory.*

Mittheilungen der Hamburger Sternwarte, No. 5. Bemerkungen und Berichtigungen zu Carl Rümker's Hamburger Stern catalogue 1836·0 und 1850. 2te serie by R. Schorr; pp. 37.

Sternwarte Hamburg. Bericht des Direktors Professor G. Rümker für 1897 und 1898; pp. 5 und 4.

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Page	3,	line	3	from	bottom—*for*	transits	*read*	stars.
„	15,	„	5	„	top „	Jupiter	„	Jupiter's.
„	24,	„	10	„	top „	obstetricia	„	Obstetricia.

Ann Arbor University
Michigan.
The United St

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1900,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, the Astronomical Society of the Pacific, and the British Astronomical Association.

Corresponding Member of the Alliance Scientifique Universelle of Paris, of the Queensland Branch of the Royal Geographical Society of Australasia, and of the Sociedad Cientifica "Antonio Alzate" of Mexico.

SYDNEY:

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CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY,

For 1900.

Various causes have combined to diminish the usual amount of annual work. It will be seen from the following report that the work was mainly done during the winter months.

Buildings and Instruments.

These remain as they were at the close of 1897, except that a considerable amount of painting was done.

Adopted Position of the Observatory.

The following co-ordinates are still adopted, namely:—

Longitude = 10h. 3m. 20·5s. E. of Greenwich.

Astronomical latitude = $-33°\ 36'\ 30{\cdot}8''$.

Height of barometer cistern above the local mean tidal level = 52 feet.

Meridian Work.

The timekeeper of the Observatory during 1900 was also sidereal chronometer *John Poole*. No. 2962, which was regulated by means of the Cooke and Sons' 3-inch transit instrument. For a detailed explanation of the methods employed for the reduction of the transit observations, the reader is referred to the Report for 1890. The equatorial distances in sidereal time of the outer wires of the transit system from the middle wire as determined from all the transits of circumpolar stars during 1899 were:—

A = +20·189s., B = +10·494s., D = −9·319s., E = −19·014s.,

with a reduction of +0·470s. to the middle wire when all five wires were observed, and these values were employed and remained

practically unchanged during 1900. The transits of all the circumpolar stars during 1900 give the following for the corresponding values:—

A = +20·196s., B = +10·497s., D = −9·312s., E = −19·009s., with a reduction of +0·474s. to the middle wire. These values will be employed for the reduction of the observations of 1901.

The following is a summary of the work for 1900:—

Nights on which the local time was determined		83
Transits observed of stars with a declination not exceeding 40°		423
Transits of stars of high declination observed for azimuth ...		107
Separate determinations of	level error	241
	collimation error	24
	azimuth error	75

The usual table is here given, showing the errors of the transit instrument and the errors and rates of the chronometer, *John Poole*, which was also always employed in the extra-meridian department. It will be seen that the inclination of the rotation axis of the transit instrument suffered frequent and sudden changes during the year; but it must be understood that level observations, three on the average, were taken each night of the time determinations. The right ascensions of both clock and azimuth stars have been taken throughout from the *American Ephemeris*, and corrected for diurnal aberration. The sidereal times of the extra-meridian observations have been converted into the corresponding solar mean times according to the method already described in previous reports.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—1900.

Mean Solar Day.	No. of Star Transits.	Clamp. E or W.	Instrumental Errors: Level.	Instrumental Errors: Collimation.	Instrumental Errors: Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1900.			″	″	″		H. M.	M. S.	S.	S.
Jan. 2	3	W.	{ +25·9 / −11·6 }	[+ 0·6]	− 4·99	μ Hydri, θ Persei	2 46	12 11·88		
„ 11	9	W.E.	+ 4·2	+ 0·8	− 1·66	ζ Arietis, ι Hydri, W.	4 41	12 41·96	0·138	
„ 12	5	E.	+ 7·1	[+ 0·8]	− 2·47	β Persei, ι Hydri	3 6	12 44·97	0·134	0·13
„ 17	3	E	{ +21·9 / − 17·8 }	[+ 0·8]	[− 1·4]		5 27	13 0·83	0·130	0·13
Feb. 6	8	E.W.	{ +61·2 / −14·6 }	+ 1·0	+ 2·80	δ Mensæ, Aldebaran, E.	5 4	14 7·04	0·137	0·14
March 8	2	W.E.	+ 5·4	+ 1·0	+ 0·40	σ Octantis, W.	7 29	15 47·77	0·139	0·13
April 2	2	E.W.	− 6·8	+ 0·8	− 0·36	βCancri, θChamæleontis E.	8 26	17 4·16	0·127	0·12
„ 7	5	W.	− 3·0	[+ 0·6]	− 0·79	η Octantis, ν Ursæ Maj.	11 29	17 19·23	0·122	0·14
„ 8	6	W.E.	− 4·6	+ 0·6	− 2·81	βCancri θChamæleontis W	8 29	17 22·15	0·139	0·14
May 18	6	E.W.	− 10 2	+ 0·6	{ − 3·47 / − 3·11 }	{ 41 Leonis Min., δ²Cha. E / η Octantis, ν Ursæ Maj. E }	11 41	19 32·56	0·135	0·12
„ 23	...	W.	+ 4·7							
„ 25	...	W.	{ +27·0 / + 1·9 }							
„ 26	...	W.	+ 9·9							
„ 31	...	W.	{ +30 8 / − 12·5 }							
June 1	3	W.	− 6·3	[+ 1·0]	+ 3·04	η Bootis, θ Apodis	14 12	20 11·67	0·116	0·10
„ 3	8	W.E	− 4·2	+ 1·0	+ 1·81	βChamæleontis, βHydri W	12 44	20 16·28	0·099	0·10
„ 10	...	E.	{ −209·8 / + 2·2 }							
„ 22	7	E.W.	{ − 29·9 / + 5·5 }	+ 0·8	+ 4·40	κ Octantis, d Bootis, E.	14 44	20 49·56	0·073	0·06

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.		No. of Star Transits.	Clamp. E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.		Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1900.				″	″	″		H.	M.	M.	S.	S.	S.
June	23	4	W.	+ 5·7	[+ 0·9]	[+ 4·0]		13	21	20	50·99	0·063	0·06
„	24	8	W.	+ 4·8	[+ 1·0]	+ 3·54	β Chamæleontis, β Hydri	12	27	20	52·52	0·066	0·09
„	25	5	W.	+ 4·7	[+ 1·0]	+ 4·16	β Chamæleontis, β Hydri	13	26	20	55·12	0·104	0·12
„	26	7	W.	+ 3·7	[+ 1·1]	+ 5·37	β Chamæleontis, β Hydri	12	50	20	58·36	0·138	0·14
„	27	6	W.E.	+ 3·4	+ 1·2	+ 4·87	β Chamæl., β Hydri, W.	12	52	21	1·76	0 141	0·16
„	28	7	E.	+ 2·8	[+ 1·2]	+ 6·58	β Chamæleontis, β Hydri	12	36	21	6·22	0·188	0·19
„	30	7	E.	+ 3 0	[+ 1·1]	+ 8·11 + 7·87	β Chamæl., β Hydri κ Octantis, η Bootis	13	42	21	15·30	0·185	0·20
July	1	5	E.	+ 3·2	[+ 1·1]	+ 7·33	β Chamæleontis, β Hydri	12	55	21	20·21	0·211	0·19
„	2	6	E.	+ 2·3	[+ 1·0]	+ 8·22	κ Octantis, η Ursæ Maj.	14	6	21	24·68	0·178	0·17
„	9	2	E.	− 47·9 − 10·9	[+ 0·9]	+ 24·70	β Leonis, δ Octantis	12	16	21	45·31	0·124	0 09
„	11	5	E.W.	− 8·4	+ 0 8	+ 24·85	κ Octantis, η Ursæ Maj. E.	14	35	21	49·08	0·075	0 08
„	12	5	W.	− 8·0	[+ 0·7]	+ 23 18	θ Bootis, α Apodis	14	38	21	50·91	0·076	0·09
„	13	4	W.	− 6·5	[+ 0·5]	+ 24·13	θ Bootis, α Apodis	15	13	21	53·28	0·096	0·11
„	14	6	W.	− 4·6	[+ 0·4]	+ 24·04	δ Bootis, ρ Octantis	15	37	21	56·10	0·116	0·11
„	15	5	W.	− 3·8	[+ 0 3]	+ 24·73	ρ Bootis, α Apodis	15	11	21	58·71	0·111	0·13
„	16	5	W.	− 1·9	[+ 0·1]	+ 25·32	ρ Octantis, α Coronæ Bor.	15	58	22	2·24	0·142	0·15
„	17	6	W.E.	− 0·7	0·0	+ 26·41 + 23·65	ρ Octantis, α Cor. Bor. W. δ^1 Apodis, τ Herculis, E.	16	15	22	6 06	0·157	0·15
„	25	6	E.W.	+ 23·0 − 5·1	+ 1·0	+ 27·20	η Ursæ Maj., θ Apodis, E.	15	31	22	25·19	0·100	0·10
„	26	2	W.	− 3·3	[+ 1·0]	+ 23·47	ζ Virginis, θ Apodis	13	55	22	27·51	0·104	0·12
„	27	3	W.	− 0·4	[+ 1 0]	+ 21·13	β Herculis, α Triang. Aus	16	59	22	31·12	0·133	0·15
„	28	4	W.	+ 1·8	[+ 1·0]	+ 23·53	θ Apodis, d Bootis	14	25	22	34·51	0·158	0·15

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp. E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1900.			″	″	″		H. M.	M. S.	S.	S.
July 29	5	W.	+ 5·7	[+ 1·0]	+20·86	δ^1 Apodis, τ Herculis	16 21	22 38·18	0·142	0·13
Aug. 2	5	W.	+14·0	[+ 1·0]	+23·93	σ Octantis	19 16	22 47·62	0·095	0·08
,, 3	6	W.	{+15·5, − 5·5}	[+ 1·0]	+23·62	δ Bootis, ρ Octantis	15 23	22 49·25	0·081	0·10
,, 4	7	W.E.	− 3·0	+ 1·0	+23·54	δ Bootis, ρ Octantis, W.	15 20	22 52·10	0·119	0·13
,, 5	5	E.	− 2·0	[+ 1·0]	+23·64	δ Bootis, ρ Octantis	15 59	22 55·59	0·142	0·13
,, 6	6	E	− 0·3	[+ 0·9]	+24·49	δ Bootis, ρ Octantis	15 18	22 58·55	0·127	0·12
,, 7	5	E.	+ 0·4	[+ 0·9]	+24·11	δ Bootis, ρ Octantis	15 48	23 1·50	0·120	0·12
,, 9	5	E.	+ 3·9	[+ 0·8]	+23·61	δ^1 Apodis, τ Herculis	16 58	23 6·88	0·109	0·11
,, 10	5	E.	+ 4·7	[+ 0·7]	+24·20	δ Bootis, ρ Octantis	15 59	23 9·49	0·113	0·12
,, 11	5	E.	+ 6·4	[+ 0·7]	+24·34	δ^1 Apodis, τ Herculis	16 25	23 12·36	0·117	0·10
,, 12	2	E.	+ 7·2	[+ 0·6]	[+24·1]		17 31	23 14·65	0·091	0·09
,, 13	7	E.W.	+ 8·8	+ 0·6	{+25·13, +22·64}	{δ^1 Apodis, τ Herculis, E., α Trian. Aus., κ Oph., W.}	16 37	23 16·56	0·083	0·11
,, 14	3	W.	{+10·8, − 9·3}	[+ 0·6]	+25·51	ϵ Serpentis, δ^1 Apodis	16 2	23 19·68	0·133	0·14
,, 15	6	W.	− 6·2	[+ 0·6]	+25·61	δ^1 Apodis, τ Herculis	16 20	23 23·17	0·144	0·15
,, 17	5	W.	− 3·0	[+ 0·7]	+25·68	γ Apodis, β Herculis	16 59	23 31·17	0·164	0·20
,, 18	5	W.	− 2·4	[+ 0·7]	+25·98	δ^1 Apodis, τ Herculis	16 33	23 36·44	0·224	0·22
,, 19	4	W.	+ 0·4	[+ 0·7]	+28·32	γ Apodis, κ Ophiuchi	17 19	23 41·69	0·212	0·22
,, 20	6	W.	+ 0·9	[+ 0·8]	+24·92	α Trianguli Aust., d Herc.	16 42	23 46·93	0·224	0·23
,, 21	6	W.	+ 2·2	[+ 0·8]	+25·75	σ Octantis	17 18	23 52·83	0·240	0·22
,, 22	3	W.E.	+ 3·6	+ 0·8	[+25·8]		17 28	23 57·52	0·194	0·19
Sept. 16	1	E.	{+34·0, +14·8, − 8·2}	[+ 1·4]	[+28·2]		20 7	25 20·77	0·138	0·11

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp. E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1900.			″	″	″		H. M.	M. S.	S.	S.
Sept. 18	6	E.W.	− 6·4	+ 1·4	+28·40	σ Octantis, E.	19 25	25 25·68	0·104	0·10
„ 27	3	W.	+ 2·0	[+ 1·0]	+28·50	Altair, ϵ Pavonis	20 6	25 48·59	0·106	0·11
„ 28	6	W.E.	+ 1·7	+ 1·0	+26·12	λ^1 Octantis, π^2 Cygni, E.	21 42	25 52·75	0·163	0·18
„ 29	9	E.	+ 2·7	[+ 1·0]	+27·01 +27·42	δ Cygni, ϵ Pavonis π^2 Pegasi, υ Octantis	21 11	25 57·25	0·192	0·16
„ 30	6	E.	+ 3·9	[+ 1·0]	+26·68	υ Octantis, α Lacertæ	21 30	26 0·45	0·132	0·13
Oct. 1	6	E.	+ 4·9	[+ 1·0]	[+26·6]		20 38	26 3·59	0·136	0·12
„ 2	7	E.	+ 5·5	[+ 1·0]	+26·44	λ^1 Octantis, π^2 Cygni	21 3	26 6·30	0·111	0·12
„ 3	6	E.W.	+ 6·7	+ 1·0	[+26·0]		20 38	26 9·16	0·121	0·14
„ 4	5	W.	+ 8·4	[+ 1·1]	+25·63	δ Cygni, ϵ Pavonis	20 1	26 12·88	0·159	0·17
„ 6	3	W.	+ 9·2	[+ 1·3]	[+24·9]		22 32	26 22·11	0·183	0·18
„ 7	5	W.	+10·6	[+ 1·5]	+24·47	λ^1 Octantis, π^2 Cygni	21 1	26 26·27	0·185	0·20
„ 8	6	W.	+10·3	[+ 1·6]	+24·44	λ^1 Octantis, 16 Pegasi	21 13	26 31·31	0·208	0·20
„ 10	5	W.E.	+13·0	+ 1·8	[+24·2]		20 38	26 39·98	0·183	0·18
„ 28	5	E.	+38·1 + 0·7	[+ 0·5]	+21·54	γ^1 Octantis, π Andromedæ	0 15	28 6·77	0·199	0·25
„ 29	8	E.W.	+ 4·5	+ 0·4	+22·10	λ^1 Octantis, π^2 Cygni, E.	22 59	28 12·52	0·253	0·25
„ 30	7	W.	+ 7·6	[+ 0·4]	+22·67	π^2 Pegasi, υ Octantis	23 9	28 18·60	0·252	0·25
Nov. 22	6	W.E.	+50·5 −15·3	+ 1·6	+12·97	γ^1 Octantis, ω Piscium E.	23 55	29 54·39	0·173	0·14
„ 23	3	E.	−15·0	[+ 1·5]	+12·47	λ Andromedæ, γ^1 Octantis	0 7	29 57·66	0·138	0·14
Dec. 12	3	E.	− 5·0	[+ 0·5]	+11·31	ϵ Tauri, δ Mensæ	4 55	30 38·81	0·089	0·11
„ 13	5	E.W.	− 5·6	+ 0·4	[+11·7]		1 51	30 41·15	0·112	0·13
„ 15	5	W.	− 2·8	[+ 0·6]	+12·53	β Andromedæ, κ Tucanæ	1 37	30 49·58	0·176	0·15
„ 16	6	W.	− 0·2	[+ 0·7]	+12·54	μ Hydri, β Persei	3 3	30 53·25	0·144	0·15

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp. E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1900.			″	″	″		H. M.	M. S	S.	S.
Dec. 17	2	W.	+ 4·6	[+ 0·8]	[+12·5]		3 26	30 56·86	0·148	0·15
„ 21	2	W.	+ 6·9	[+ 1·2]	[+12·6]		3 44	31 14·19	0·180	0·15
„ 25	3	W.E.	+11·1	+ 1·6	[+12·6]		1 56	31 25·60	0·121	0·11
„ 26	6	E.	+12·4	[+ 1·5]	+12·62	γ Trianguli, μ Hydri	2 23	31 28·13	0·103	0·11
„ 27	6	E.	+13·9	[+ 1·5]	+11 43	γ Trianguli, μ Hydri	2 26	31 30·92	0·116	0·12
„ 29	6	E.	+19·5	[+ 1·3]	+12·22	μ Hydri, β Persei	3 53	31 36·63	0·115	...
„ 31	...	E.W.	...	+ 1·2	...		...	...	...	...

NOTES.

1900.

January 2, 17—The eastern pivot was raised during the observations.
February 6— The eastern pivot was raised 75·8″ before the observations.
March 8— Observations could not be obtained with the clamp east.
April 2— Observations could not be obtained with the clamp west.
May 23— The level error this evening was found to be +4·7″
May 25— The sudden fall of the eastern pivot between May 23rd and 25th, was probably due to heavy rain; 4·47 inches fell from 21st to 25th. The eastern pivot was raised 25·1″
May 31— The eastern pivot was raised 43·8″ about noon, and the level error was then −12·5″
June 10— The eastern pivot was lowered 212·0″ at noon, the rise being doubtless due to rain, which amounted to 3·38 inches in four days.
June 22— The eastern pivot was lowered before the observations.
July 9— The eastern pivot was lowered before the observations, and the azimuth was probably changed by the adjustment.
July 25, Aug. 3—The eastern pivot was raised before the observations.
August 14— The eastern pivot was raised during the observations.
August 22— Observations could not be made with the clamp east.
September 16—The eastern pivot was raised both before and after the observation.
October 28— The eastern pivot was raised after the first transit.
November 22—The eastern pivot was raised before the observations. 2·93 inches of rain fell from 18th to 20th.
December 25—Observations could not be made with the clamp east.
December 31—Transits could not be observed since December 29, but the collimation error was now determined.

Extra-Meridian Work.

OCCULTATIONS OF STARS BY THE MOON.—Twenty-six phases of these phenomena were observed at the moon's dark limb, of which twenty-five were disappearances and one was a re-appearance. Altogether 1127 phases have been observed since systematic work was commenced in this department in 1864. The results of the work for 1900 will shortly be ready for publication.

PLANET OBSERVATIONS.—The 8-inch equatorial, with its filar-micrometer, has been employed, with the following results:—

Planets.	Nights of Observation.	Comparisons.	Comparison Stars.
Jupiter ...	... 5	... 92	... β Scorpii
(1) Ceres ...	... 23	... 317	... 9
(3) Juno ...	... 8	... 96	... 6
(6) Hebe ...	... 13	... 189	... 4

The observed positions have been kindly compared by Mr. C. J. Merfield, F.R.A.S., with the ephemerides, and the complete results have been forwarded to the *Astronomische Nachrichten*.

COMET OBSERVATIONS.—There was no comet well placed for observation. A careful but unsuccessful search was made on three nights for Brorsen's Comet in accordance with an approximate ephemeris kindly furnished by Professor Kreutz. Late in the evening of December 24, which was very cloudy, I received a telegram from the Melbourne Observatory, announcing the discovery of a comet by Giacobini, and giving its position for December 20D. 7h. 30m. 43s. G.M.T., as R.A. =22h. 32m. increasing 6m. daily, and N.P.D. =112° increasing 8′ daily. The sky on the evening of the 26th was beautifully clear, but notwithstanding a careful search for a considerable distance round the estimated position for the comet, I failed to find it. On the evening of the 27th, I received another telegram giving its place for December 24D. 6h. 30m. 14s. G.M.T., as R.A. =22h. 15m., and N.P.D. =112° 45′, which made it appear that the former telegram was erroneous, whereas it subsequently turned out that the right ascension of the latter was grossly in error. Cloudy weather and strong moonlight prevented a further search.

OCCULTATION OF JUPITER AND HIS SATELLITES.—The observation of this interesting phenomenon with the 8-inch equatorial was very successful, and the results have been sent to the Royal Astronomical Society. The predicted times for the planet were kindly furnished by Mr. C. J. Merfield.

Double-Star Observations.—Twenty-five pairs of the most interesting southern double stars were measured with the 8-inch equatorial. Measures were made on thirty-six nights, 707 readings being taken for position angle, and 454 double readings for distance. The results have been sent to the Royal Astronomical Society.

In addition to the observations already referred to, a few observations were made of the phenomena of Jupiter's satellites.

Meteorological Observations.

The following table gives the meteorological results for 1900, obtained in a manner similar to that explained on page 15 of the Report for 1898:—

1900.	Temperatures.				Rainfall.			
	Highest Shade.	Lowest Shade.	Highest in Sun, Black Bulb in Vacuo.	Lowest Radiation on Grass.	Gauge 6·8 feet above Ground.	Gauge 22·0 feet above Ground.	Greatest Daily Fall by Lower Gauge.	Date 9h. a.m.
	°	°	°	°	Inches	Inches	Inches	
January	113·0	51·7	161·6	44·9	1·746	1·622	0·340	11
February	115·9	55·8	158·1	49·5	0·836	0·818	0·322	28
March	108·3	46·4	155·5	40·0	2·214	2·050	0·896	31
April	91·7	42·2	142·8	34·7	1·898	1·789	0·608	29
May	78·3	32·1	129·9	27·4	6·010	5·813	2·308	23
June	75·6	41·6	115·0	31·6	4·951	4·580	1·727	7
July	69·3	29·2	118·8	25·2	9·597	9·220	2·689	5
August	75·6	29·2	127·2	25·5	0·773	0·752	0·380	27
September	85·7	35·6	132·8	32·3	1·105	1·070	0·289	21
October	102·7	37·1	151·2	33·5	0·327	0·312	0·289	28
November	109·0	52·9	159·2	48·1	3·804	3·532	1·413	18
December	109·6	50·4	157·6	45·1	1·129	1·000	0·359	24
Year..	115·9	29·2	161·6	25·2	34·390	32·558	2·689	July 5

In accordance with the suggestion recorded on page 17 of the last Annual Report, I have had constructed a Stevenson's themometer screen exactly similar to that employed at the Hawkesbury Agricultural College. It has been placed beside the old Greenwich stand employed at this Observatory during the past thirty-eight years, and a series of themometer comparisons is now being conducted in order to get an equation between the results derived from the two methods of exposure. I trust to be able to give, in my Report for 1901, a table embodying the results of these comparisons. The readings in the Greenwich stand are, as anticipated, considerably higher than those in the Stevenson's screen.

The following is a statement of the floods and freshes that have occurred at Windsor during the years 1898, 1899, and 1900. It may

be regarded as a continuation of the Catalogue for 42 years, published at the close of my Meteorological Observations for 1891-97 :—

1898.

A flood occurred in the night of February 15 – 16; it rose to a height of 31·7 feet above the local mean tidal level. Slight freshes occurred on or about January 27, May 6, June 10, 23, 27, August 7, September 5, and October 22.

1899.

Flood at Mulgrave and some water in the Peninsula on July 13. A large flood at Mulgrave and considerable portion of the Peninsula inundated on August 13; the height was 22·2 feet. Another flood attained its maximum on August 24. It rose to a height of 26·7 feet; the Observatory Hill was not quite surrounded.

1900.

Slight freshes on or about February 16, April 5, and June 8. A small flood, with two maxima, on May 24 and 26. The River and South Creek rose rapidly on July 5, and a flood, which is the third in order of descending magnitude for the past 46 years, attained its maximum early in the morning of the 7th. It rose to a height of 46·2 feet above the mean tidal level, and threatened the Observatory buildings. The floors of the main observatory and of the circular equatorial room were only 21 and 7 inches respectively above the flood level. In consequence of the rapid rise of the flood at the beginning, the currents were unusually strong, and much fencing was destroyed. There was a small flood at Mulgrave on July 21; and a fresh in the Creek for some days preceding November 24.

Publications.

The following papers have been published in astronomical journals since the issue of the last annual Report:—

STAR OCCULTATIONS BY THE MOON, OBSERVED IN 1899.—*Astronomische Nachrichten*, Band CLIII., p. 69.

EQUATORIAL COMPARISONS OF MINOR PLANETS (4) VESTA AND (7) IRIS IN 1899.—*Royal Astronomical Society's Monthly Notices*, Vol. LX., p. 566.

OBSERVATIONS OF PHENOMENA OF JUPITER'S SATELLITES IN 1898 AND 1899.—*R A.S. Monthly Notices*, Vol. LX., p. 620.

ON THE VARIABLE STAR η ARGUS.—*The Observatory*, Vol. XXIII., p. 256.

Observations Recently Utilised.

It was mentioned under this heading in the last Report that the local observations of Comets VII., 1898, and I., 1899, were extensively used by Mr. C. J. Merfield in his determinations of provisional orbit-elements of these bodies. Since the publication of the last Report, however, Mr. Merfield has published a definitive orbit of the former comet in Nos. 3684 and 3685 of the *Astronomische Nachrichten*. The local observations form a very large proportion of the data employed in the investigation. Owing to the very large number of published positions of this comet, the definitive investigation has been exceedingly laborious, and the author is to be congratulated on its successful issue. It is a work which cannot fail to be appreciated by astronomers, and it will form an important item in our local astronomical literature. It plainly shows that if the author be only blessed with good health, and the necessary opportunities, he will have a brilliant astronomical career before him, and one which will do honour to the State of which he is a member.

The Library.

It will be seen from the list which follows of donations for 1900, that the Library has been increased by contributions from 52 public institutions and 12 private individuals. For these contributions the proprietor returns his best thanks, and he only regrets that in consequence of his establishment being but a private one, he is unable to meet such kindly consideration with an adequate return.

Conclusion.

All the observations and reductions, both astronomical and meteorological, have been made by the proprietor. The year 1901 will be devoted mainly to the observation of double-stars, and as a guide to this work he will gladly avail himself of the splendid Reference Catalogue of Southern Double-Stars, compiled by Mr. R. T. A. Innes, F.R.A.S., of the Royal Observatory, Cape of Good Hope.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1900.

[NOTE.—The names of the Donors are printed in italics.]

Results of Rain, River, and Evaporation Observations in New South Wales in 1898; pp. lv., 235, with maps, etc.

Current Papers, No. 4, by H. C. Russell, C.M.G., &c., pp. 145 – 149, with tables and plates. *The Government Observatory, Sydney.*

The Surveyor for 1900.—Jan. 22, Feb. 24, March 27, April 30, May 21, June 28, July 25, Aug. 28, Sept. 21, Oct. 31, Nov. 30.

Thirty *The Institution of Surveyors, N. S. Wales.*

~~Twenty~~-fourth Annual Report of the Melbourne Observatory, 1899, March 1, to 1900, March 31, pp. 8.

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory, and Other Places in Victoria, for Half-Years ended 1898, Dec. 31; 1899, June 30; and 1899, Dec. 31; pp. 43, 48, 49. *The Government Observatory, Melbourne.*

Meteorological Observations at Adelaide Observatory and Other Places in South Australia and the Northern Territory during 1897; pp. xiv., 95, 77, with maps.
The Government Observatory, Adelaide.

Queensland Geographical Journal (new series) 15th Session, 1899 – 1900, Vol. XV., pp. 141, with maps.
The Queensland Branch of the R. Geographical Society of Australasia.

Weekly Weather Reports, 1899, Nov. 25, to 1900, Nov. 17, complete, with Title and Preface for 1899; Vol. XVI.

Monthly Summaries of Observations at Stations in the Daily and Weekly Weather Reports for 1899, August, to 1900, July; complete.

Quarterly Summaries of the same, 1899, Oct. – Dec.; 1900, Jan. – March, and April - June.

Quarterly Summary of the Weekly Weather Report, 1900.

Summary of the Weekly Weather Report, 1899; Values for the year.

Weekly Weather Report: Rainy Days during 1899.

Diurnal Range of Rain at the Seven Observatories of the Meterological Office, 1871 – 90, by R. H. Scott, F.R.S., &c.; pp. 48.

Meteorological Observations at Stations of the Second Order, for 1896; pp. 186, with maps.
Report of the Meteorological Council for the Year 1899, March 31; pp. 136.
Report of the International Meteorological Committee, St. Petersburg, 1899; pp. 110.
Hourly Means of Readings of the Self-Recording Instruments at the Five Observatories under the Meteorological Council, 1896; pp. xi., 239.
Indian Meteorological Memoirs, Vol. X., Parts III. and IV.

The Meteorological Office, London.

Annals of the Royal Observatory, Cape of Good Hope, Vol. II., Part II.: Reference Catalogue of Southern Double-Stars, by R. T. A. Innes, F.R.A.S.; pp. xvi. A., 314 A.
Catalogue of 2798 Zodiacal Stars for 1900; pp. 77.
Catalogue of 3007 Stars for 1890, from Observations at the Royal Observatory, Cape of Good Hope, 1885 - 1895, with Sundry Appendices; pp. xliv., 263.

The Lords Commissioners of the Admiralty.

Twenty-fifth Report of the Oxford University Observatory, 1899 – 1900.

The Oxford University Observatory.

Astronomical Observations and Researches at Dunsink Observatory of Trinity College, Dublin; 9th Part, pp. xii., 75.

The Dunsink Observatory.

Report of the Liverpool Observatory, Bidston, Birkenhead, and Meteorological Results for 1899, pp. 51.

The Liverpool Observatory.

Report of the Kew Observatory for 1899; pp. 35.

The Kew Observatory.

Report of the Temple Observatory, Rugby, for 1899; pp. 3.

The Temple Observatory.

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory for 1899; pp. 83.

Stonyhurst College Observatory.

Report and Results of Meteorological Observations for 1899 at Fernley Observatory, Southport; pp. 28, with plates.

The Fernley Observatory, Southport.

Variable Star Notes, No. 6: Observations of T. and R. Cassiopeiæ; pp. 16, with diagrams.
Meteorological Observations at Rousdon Observatory, for 1899; Vol. XII., p. 32.

The Rousdon Observatory, Devon.

Report of the Royal Observatory, Cape of Good Hope, for 1899, pp. 18.
Independent Day-Numbers for 1902, as used at the Royal Observatory, Cape of Good Hope; pp. 14.

The Royal Observatory, Cape of Good Hope.

Monthly Weather Review, 1899, September, to 1900, August, complete.
Toronto General Meteorological Register for 1899; pp. 11.

The Meteorological Office, Toronto.

Madras Meridian Circle Observations, Vol. IX.: General Catalogue of 5303 Stars for 1875; pp. xxviii., 314.

Report on the Kodaikanal and Madras Observatories for 1899 – 1900; pp. 18. *The Madras Observatory.*

Observations at the Hongkong Observatory in 1899; pp. 13 (139). *The Hongkong Observatory.*

Report of the U.S. Naval Observatory for Year ended 1899, June 30; pp. 27. *The U.S. Naval Observatory, Washington.*

Astronomical Tables for the Use of the American Ephemeris and Nautical Almanac: Vol. VII., Part III., Tables of Uranus, by S. Newcomb; pp. 287 to 416. Also, Vol. VII., Part IV., Tables of Neptune, by S. Newcomb; pp. 417 to 471.

Total Eclipse of the Sun, 1900, May 28: Suppl. to the American Ephemeris for 1900; pp. 32 with maps.

The American Ephemeris and Nautical Almanac for 1903, 1st Ed., pp. 591. *Office of the American Ephemeris.*

Fifty-fourth Annual Report of Harvard College Observatory for Year ended 1899, Sept. 30; pp. 13, with plates.

Annals of the Harvard College Observatory, Vol. XXXII., Part II: Visual Observations of the Moon and Planets; pp. 117 to 317, with plates. Vol. XXXIII., containing Miscellaneous Researches during 1894 - 1899, pp. 287. And Vol. XLIV., Part I., Photometric Revision of the Harvard Photometry during 1891 - 1894; pp. 110. *The Harvard College Observatory.*

Bulletin of the Yerkes Observatory, No. 12: Carbon in the Chromosphere; pp. 3. No. 13: Variable Star Observations with the 12-inch and 40-inch Refractor; pp. 52 to 54. No. 14: Observations of the Total Solar Eclipse of 1900, May 28, at Wadesboro, N.C.; pp. 80 to 89, with plates. And No. 15: Photographs of Star Clusters with the 40-inch Visual Telescope; pp. 161 to 163, with plate.

First Annual Report of the Yerkes Observatory for the Year ended 1898, Sept. 30; pp. 11.

Publications of the Yerkes Observatory, Vol. I., 1900: General Catalogue of 1290 Double Stars, discovered by S. W. Burnham, 1871 to 1899, with Measures; pp. xxx., 296. *The Yerkes Observatory.*

The Pressing of Steel, with especial reference to Economy in Transportation, by H. V. Loss, M.E.; pp. 21.

What is Parianite? by S. F. Peckham; pp. 21. *The Franklin Institute, Philadelphia.*

Proceedings of the American Philosophical Society, Vol. XXXVIII., 1899, Dec.; pp. 133 to 196, with plates. And Vol. XXXIX., 1900, Jan. to March; pp. 125, with plates. *The American Philosophical Society.*

The Astronomical and Astrophysical Society of America, Second Meeting, New York, 1900; pp. 64. *The Astronomical and Astrophysical Society of America.*

Rapport Annuel sur l'Etat de l'Observatoire de Paris, pour 1899; pp. 34. *The Paris Observatory.*

Annales de l'Alliance Scientifique Universelle, 1899: Nos. 125 and 126. *L'Alliance Scientifique Universelle.*

Genäherte Oppositions-Ephemeriden von 67 kleinen Planeten für 1900, Januar bis August; pp. 23. Und von 40 kleinen Planeten für 1900, Juli bis December; pp. 14.

Planeten-Elemente nebst Angaben über die Oppositionen und Oppositions-Ephemeriden kleiner Planten für 1900; pp. 383 to 478. *Konig. Ast. Recheninstitut, Berlin.*

Publicationen der Sternwarte in Kiel, X.: Ueber die Zeitbestimmung im Verticale des Polsternes, von P. Harzer; pp. 74. *The Royal Observatory, Kiel.*

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Astronomische Beobachtungen auf der Koniglichen Universitäts-Sternwarte zu Konigsberg. Abtheilungen 38 and 39. *The University Observatory, Konigsberg.*

Bericht über den Stand der Erforschung der Breiten variation am Schlusse des Jahres, 1899, von. Th. Albrecht; pp. 26, with plate. *Central Bureau der Internationalen Erdmessung, Berlin-Potsdam.*

Mittheilungen der Hamburger Sternwarte, No. 6. Beobachtungen der Zone 80° bis 81° nördlichen Declination; pp. 155.

Sternwarte Hamburg. Bericht von Dr. R. Schorr, aus dem Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten für 1899; pp. 8. *The Hamburg Observatory.*

Jena (Universitäts-Sternwarte). Bericht, 1899; pp. 2.

Hermann Struve, Beobachtungen der Saturnstrabanten am 36 zolligen Pulkowaer Refractor, von O. Knoff; pp. 268 to 288. *The University Observatory, Jena.*

Publicationen der v'Kuffner'schen Sternwarte in Wien, Band V. *von Kuffner's Sternwarte, Vienna.*

Beobachtungen angestellt am astrophysikalischen und meteorologischen Observatorium in O'Gyalla, 1896, 1897, und 1898. Banden XIX., XX., and XXI., with plates. *The Observatory, O'Gyalla.*

Jahrbuch der meterologischen und erdmagnetishchen Beobachtungen, Band IV. Beobachtungen, 1899; pp. vii., 180, with diagrams.

Resultate aus den Meteorologischen Beobachtungen in Pola, von 1867 bis 1897; pp. xxxix., 96, with diagrams.

Meteorologische Termin-Beobachtungen in Pola, Sebenico, und Teodo: 1899, Oct.-Dec.; 1900, Jan.-Sept.

Monats und Jahresübersicht nach den Termin-Beobachtungen in Pola, &c., 1899. *Hydrographische Amt in Pola.*

Magnetische und Meteorologische Beobachtungen am der K. K. Sternwarte zu Prag im 1899; pp. xvii., 41. *The Imperial Observatory, Prague.*

Thätigkeit der Manora Sternwarte im Jahre, 1898; pp. 129 - 134. *The Manora Observatory.*

Societé de Physique et d'histoire naturelle de Genève. Seance du 1re Fevrier, 1900; pp. 13. *The Geneva Observatory.*

Publications of the Astronomical Laboratory at Groningen: No. 1, The Parallax of 248 Stars around B.D. +35.4013, contained on Photographs by Prof. A. Donner, measured and discussed by Prof. J. C. Kapteyn; pp. 98. Nos. 2 and 3: On the Systematic Difference depending on Galactic Latitude, between the Photographic and Visual Magnitudes of the Stars, by W. De Sitter; and, On Isochromatic Plates, by same; pp. 26.

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Ephemeridi del Sole e della Luna per l'orrizonte di Torino, by L. Gabba, 1900 and 1901; pp. 21 and 18.

Le Ore di Sole Rilevate a Torino mediante l'Eliofanometro nel 1896 - 98, Dr. L. Carnera; pp. 19, with plates.

Osservazioni Meteorologiche fatte all'Osservatorio della R. Universita di Torino, 1898 and 1899; pp. 53 and 53.

Sul Movimento non Perturbato di un Pianeta intorno al Sole nota di F. Porro; p. 11. *The University Observatory, Turin.*

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All'Astronomo. G.V. Schiaparelli, 30 Giugno, 1860 – 30 Giugno, 1890; pp. 84. *The Observatory, Padua.*

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The Private Observatory of V. Cerulli, Teramo.

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Eclipses du Soleil Interieur; pp. 15, with coloured plate.

Instituto Solar Internacional, Uruguay.

Boletine Mensal do Observatorio do Rio de Janeiro, 1900, Janeiro, Fevereiro, Marco, Abril; pp. 72.

The Observatory, Rio de Janeiro.

Boletin Mensual Meteorologico y Agricola del Observatorio Central del Estado de Vera Cruz Llave, 1898, Marzo, Abril; 1899, Enero; 1900, Enero.

The Meteorological Observatory, Vera Cruz.

Boletin Mensual del Observatorio Meteorologico del Estado de Oaxaca. Tome III., No. 7; and Tome IV., Nos. 1 and 2.

The Meteorological Observatory, Oaxaca.

Observations on the Determination of Drought Intensity, by G. H. Knibbs, F.R.A.S.; pp. 69 to 85.

Some Applications and Developments of the Prismoidal Formula, by same; pp. 129 to 145. *The Author.*

Orbit-Elements of Comet I., 1899 (Swift), by C. J. Merfield, F.R.A.S.; pp. 177 - 192, two copies.

The Surveyor, 1900, March 27. *C. J. Merfield, F.R.A.S.*

Anniversary Address, by W. H. Hamlet, before the Royal Society of N. S. Wales, 1900, May 2; pp. 35. *The Author.*

Nathan's Weather Forecast for 1900; sheet, 2 copies. *The Author.*

Notes on Temperature Observations at Dunsink Observatory during the Eclipse of the Sun, 1900, May 28, by C. Martin; pp. 362 - 364, with plate. *The Author.*

On the Brightness of the Corona of 1893, April 16. Preliminary Notes, by H. H. Turner, M.A., &c.; pp. 403 - 409.

A Suggestion for the Explanation of Stationary Radiant Points of Meteors, by same; pp. 139 - 151.

Note on Dr. Gill's Paper "On a New Instrument for Measuring Astrophotographic Plates, by same; pp. 133 - 139.

On the Distribution of Stars Photographed at the University Observatory, Oxford, for the Astrographic Catalogue for Zones +25° to +29°, by F. A. Bellamy; pp. 11 - 17.

On the Variation of Personal Equation with Stellar Magnitude in Observations made at Cambridge, Berlin, and Greenwich, &c., by H. H. Turner, M.A., &c.; pp. 1 - 12.

Observations of the Leonids of 1899 at the University Observatory, Oxford, by same; pp. 163 - 165.

On the Proper Motions of Berlin B Nos. 5072 and 5073, by F. A. Bellamy; pp. 125 - 127.

Some Suggestions for the Explicit Use of Direction Cosines or Rectangular Co-ordinates in Astronomical Computations, by H. H. Turner, M.A., &c.; pp. 201 - 210.

On a Simple Method of Comparing the Bonn Durchmusterung, with Photographic Plates, by same; pp, 427 - 433.

On Stationary Radiants of Meteors, by same; pp. 449 - 458.

On the Alleged Rotation of the Spiral Nebula 51 Canum Venaticorum, by same; pp. 529 - 531.

Professor H. H. Turner, M.A., F.R.S., &c.

A List of 47 New Double Stars and Measures of 204 Double Stars, by R. G. Aitken; pp. 161 - 170. *The Author.*

Observations of Double Stars with the 26-inch Equatorial at the U.S. Naval Observatory, by S. J. Brown; pp. 329 - 350. *The Author.*

Mansill's Almanac of Planetary Meteorology for 1900. *The Author.*

Une Nuit a l'Observatoire du Puy-de-Dome, 10 - 11 Août, 1899, par L. Libert; pp. 4.

G. V. Schiaparelli et W. F. Denning, par L. Libert; pp. 12. *The Author.*

Zusammenstellung der Kometen-Erscheinungen des Jahres 1899, von H. Kreutz; pp. 69 - 79; 2 copies. *The Author.*

Osservazioni Astronomiche e Fisiche sulla Topografia Constituzione del Pianeta Marte durante l'opposizione del 1888, G. V. Schiaparelli; pp. 114, with plates. *The Author.*

ERRATA IN THE REPORT FOR 1899.

Page 7. Opposite to April 16 *insert* W. after 19 Leonis Minoris.

„ 12 and 13. At the head of the last column but two *for* Transit *read* Transits.

„ 21, line 20 from top, *for* Part III., *read* Part II.

JUL 31 1902

Ann Arbor Observatory
Ann Arbor,
Michigan
The United States

REPORT

OF

Mr. Tebbutt's Observatory,

Astron. Obs.

520.5
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THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1901,

BY

JOHN TEBBUTT

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, and the British Astronomical Association.

Corresponding Member of the Alliance Scientifique Universelle of Paris, of the Queensland Branch of the Royal Geographical Society of Australasia, and of the Sociedad Cientifica "Antonio Alzate" of Mexico.

SYDNEY:
F. W. WHITE,
39 MARKET STREET, WEST.

1902

REPORT

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1902

CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY,

For 1901.

It will be seen from the following Report that the work for 1901 shows a considerable increase on that of the year preceding.

Buildings and Instruments.

There is nothing to add under this head; but it will be well to furnish anew a list of the Instruments with which the Observatory is equipped. They are as follow :—

Transit Instrument (by Cooke and Sons, of York) of 3 inches aperture and 36 inches focal length, with striding level, whose divisions are each equal to 0·8″, and various eye-pieces.

Two Eight-day Sidereal Box Chronometers (one by Parkinson and Frodsham, No. 1042, and the other by John Poole, No. 2962), both beating half-seconds.

Equatorial Refractor (by Grubb, of Dublin, 1882) of 8 inches aperture and 115 inches focal length, driven by clockwork, with filar-micrometer and various eye-pieces by the same maker.

Equatorial Refractor (by Cooke and Sons, of York) of 4¼ inches aperture and 70 inches focal length, with position and distance filar-micrometer and various eye-pieces by the same makers. The micrometer is also adapted to the 8-inch instrument.

Two Ring Micrometers and a Square Bar Micrometer, adaptable to both the equatorials.

Portable Refractor (by Chas. Jones, of Liverpool) of 3¼ inches aperture and 48 inches focal length.

5-inch Theodolite, 7½-inch Sextant, and other minor appliances.

For a complete description of the various Instruments, the reader is referred to the History and Description of the Observatory, published in 1887.

Position of the Observatory.

This is still adopted as—

Longitude=10h. 3m. 20·5s. E. of Greenwich.

Astronomical latitude= $-33° 36' 30·8''$.

Height of barometer cistern above the local mean tidal level = 52 feet.

Meridian Work.

This was done by means of the chronometer John Poole, No. 2962, and the 3-inch Cooke and Sons' transit instrument. A detailed explanation of the methods employed for the reduction of the transit observations will be found in the Reports for 1888, 1889, and 1890. The equatorial distances in sidereal time of the outer wires of the transit system from the middle wire, as determined from all the transits of circumpolar stars during 1900, were:—

A = +20·196s., B = +10·497s., D = −9·312s., E = −19·009s.,

with a reduction of +0 474s. to the middle wire when all five wires were observed, and these values were employed and remained sensibly constant during 1901. The transits of all the circumpolar stars during 1901 give the following for the corresponding values:—

A = +20·191s., B = +10·488s., D = −9·322s., E = −19·000s.,

with a reduction of +0·471s. to the middle wire.

The following is a summary of the work in this department for 1901:—

Nights on which the local time was determined		106
Transits observed of stars with a declination not exceeding 40°		479
Transits of stars of high declination observed for azimuth ...		109
Separate determinations of	level error	288
	collimation error	27
	azimuth error	78

The following Table exhibits the errors of the transit instrument and the errors and rates of the chronometer *John Poole*, which was also always employed in the extra-meridian department. It will be seen that the level errors throughout the year were remarkably steady, as compared with the preceding few years. This steadiness was doubtless due, in a great measure, to the circumstance that the year was a remarkably dry one. The places of the clock and azimuth stars have been taken, as heretofore, from the American Ephemeris.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—1901.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1901.			″	″	″		H. M.	M.	S.	S.	S.
Jan. 29	7	W.E.	{ + 65·4 / 0·0 }	+ 2·0	+ 5·18	δ Mensæ, τ Tauri, W.	5 38	33	36·13	0·160	0·13
„ 30	8	E.	− 0·3	[+ 1·7]	+ 4·64	δ Mensæ, τ Tauri	5 34	33	39·10	0·124	0·12
Feb. 1	5	E.	0·0	[+ 1·1]	+ 5·38	δ Mensæ, τ Tauri	4 43	33	44·83	0·122	0·13
„ 4	5	E.	+ 2·3	[+ 0·3]	+ 4·64	δ Mensæ, τ Tauri	4 43	33	55·30	0·145	0·16
„ 5	7	E.W.	+ 3·1	0·0	+ 3·34	δ Mensæ, τ Tauri, E.	5 9	33	59·43	0·169	0·17
„ 22	7	W.E.	+13·2	+ 1·4	+ 2·39	δ Doradûs, ν Orionis, E.	6 11	34	45·27	0·112	0·10
„ 23	5	E.	+13·7	[+ 1·3]	+ 2·91	δ Doradûs, β Aurigæ	5 44	34	47·65	0 101	0·11
„ 24	6	E.	+14·5	[+ 1·3]	+ 4·43	σ Octantis, S.P.	5 41	34	50·29	0.110	0·10
„ 25	5	E.	+14·6	[+ 1·2]	+ 3·08	δ Doradûs, β Aurigæ	6 14	34	52·60	0·094	0·10
„ 28	7	E.W.	+15·5	+ 1·0	+ 2·07	δ Doradûs, β Aurigæ, E.	6 48	35	0·15	0·104	0·09
Mar. 1	4	W.	{ +16·7 / − 7·2 }	[+ 1·0]	+ 1·29	δ Doradûs, β Aurigæ	6 37	35	2·14	0·084	0·09
„ 2	4	W.	− 5·7	[+ 0·9]	+ 0·06	δ Doradûs, β Aurigæ	7 12	35	4·42	0·093	0·10
„ 3	5	W.	− 3·3	[+ 0·9]	+ 1·90	δ Doradûs, β Aurigæ	6 13	35	6·78	0·103	0·11
„ 4	5	W.	− 1·3	[+ 0·9]	[+ 1·3]		6 46	35	9·77	0·122	0·12
„ 7	7	W.E.	− 0·3	+ 0·8	− 0·60	63 Aurigæ, γ^2 Pisc. Vol. W.	8 0	35	17·46	0·105	0·11
„ 27	4	E.W.	+ 7·2	+ 0·6	+ 1·70	β Cancri., θ Chamæl. W.	8 20	36	9·53	0·108	0·11
„ 28	6	W.	+ 6·9	[+ 0·6]	[+ 1·4]		9 38	36	12·33	0·111	0·11
„ 29	3	W.	+ 7·6	[+ 0·6]	+ 1·03	β Cancri., θ Chamæleontis	8 49	36	15·07	0·118	0·13
April 2	2	W.	+ 6·9	[+ 0·6]	[+ 2·3]		8 8	36	31·37	0·171	0·16
„ 5	3	W.	+ 7·8	[+ 0·6]	+ 3·32	γ^2 Pisc. Vol., β Canis Min	7 55	36	42·11	0·150	0·14
„ 7	3	W.	+ 6·4	[+ 0·6]	+ 3·86	γ^2 Pisc. Vol., β Canis Min	8 9	36	48·59	0·134	0·14

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1901.			"	"	"		H. M.	M. S.	S.	S.
April 8	3	W.	+ 5·7	[+ 0·6]	[+ 3·2]		7 50	36 52·13	0·149	0·13
„ 9	2	W.	+ 5·3	[+ 0·6]	[+ 2·5]		9 22	36 54·85	0·107	0·11
„ 12	6	W.E.	+ 4·5	+ 0·6	+ 0·51	β Cancri, θ Chamæl. E.	8 28	37 2·79	0·112	0·09
„ 13	2	E.	+ 4·3	[+ 0·6]	[+ 0·6]		11 18	37 4·91	0·079	0·09
„ 24	2	E.	+ 2·5	[+ 1·1]	[+ 1·7]		8 25	37 44·79	0·153	
May 2	4	E.	+ 1·2	[+ 1·5]	[+ 2·5]		7 14	0 6·14		
„ 3	5	E.	+ 1·1	[+ 1·5]	[+ 2·6]		6 27	0 8·40	0·097	0·10
„ 4	6	E.W.	+ 0·7	+ 1·6	+ 2·67	θ Hydræ, β Argûs, E.	10 0	0 11·05	0·096	0·10
„ 5	4	W.	+ 1·6	[+ 1·3]	+ 0·68	41 Leonis Min, δ^2 Chamæl.	10 37	0 13·61	0·104	0·11
„ 6	5	W.	+ 0·9	[+ 1·0]	+ 1·99	θ Chamæleontis, γ Cancri	9 48	0 16·38	0·120	0·12
„ 7	4	W.	+ 0·9	[+ 0·7]	+ 2·12	η Octantis, δ Leonis	10 59	0 19·49	0·123	0·13
„ 8	5	W.E.	+ 0·9	+ 0·4	+ 1·78	η Octantis, δ Leonis, W.	11 29	0 22·67	0·130	0·13
„ 9	3	E.	0·0	[+ 0·5]	[+ 2·0]		8 42	0 25·35	0·126	0·15
„ 10	5	E.	+ 0·4	[+ 0·5]	+ 2·30	41 Leonis Min, δ^2 Chamæl.	9 1	0 29·79	0·183	0·20
„ 11	4	E.	− 0·3	[+ 0·6]	+ 2·41	46 Leonis Min, η Octantis	9 45	0 35·12	0·216	0·20
„ 12	4	E.	− 0·3	[+ 0·7]	[+ 2·5]		9 57	0 39·67	0·188	0·19
„ 13	3	E.	− 0·1	[+ 0·7]	[+ 2·6]		9 1	0 43·98	0·187	0·18
„ 14	5	E.W.	− 0·9	+ 0·8	+ 2·66	β Chamæleontis, β Hydri E	11 13	0 48·55	0·174	0·18
„ 15	4	W.	− 0·9	[+ 0·9]	+ 2·02	δ^2 Chamæleontis, δ Leonis	10 39	0 52·73	0·178	0·16
„ 16	5	W.	− 0·9	[+ 1·0]	+ 0·32	η Octantis, δ Leonis	10 54	0 56·23	0·144	0·14
„ 17	5	W.	− 0·9	[+ 1·1]	+ 1·12	41 Leonis Min, δ^2 Chamæl.	10 13	0 59·43	0·137	0·14
„ 18	1	W.	− 1·0	[+ 1·3]	[+ 0·8]		10 16	1 2·85	0·142	0·14
„ 19	5	W.	− 0·5	[+ 1·4]	+ 0·51	46 Leonis Min, η Octantis	11 14	1 6·34	0·140	0·16

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1901.			"	"	"		H. M.	M. s.	s.	s.
May 20	3	W.	− 0·8	[+ 1·5]	[+ 2·1]		11 55	1 10·88	0·184	0·19
„ 21	6	W.E.	− 1·3	+ 1·6	+ 3·67	βChamæleontis, βHydri E.	11 36	1 15·58	0·198	0.22
„ 22	5	E.	− 1·7	[+ 1·5]	+ 1·57	46 Leonis Min, η Octantis	11 30	1 21·55	0·250	0·25
„ 23	5	E.	− 1·9	[+ 1·4]	+ 0·99	η Octantis, δ Leonis	11 30	1 27·61	0·253	0·23
„ 24	5	E.	− 2·3	[+ 1·3]	+ 2·24	β Chamæleontis, β Hydri	11 20	1 32·71	0·214	0·21
„ 25	4	E.	− 2·8	[+ 1·2]	[+ 2·3]		11 25	1 37·47	0·198	0·19
„ 28	5	E.	− 2·2	[+ 0·8]	+ 2·48	β Chamæleontis, β Hydri	11 57	1 48·66	0·154	0·14
„ 29	7	E.	− 2·5	[+ 0·7]	+ 1·06	β Chamæleontis, β Hydri	12 30	1 52·08	0·139	0·15
„ 30	6	E.W.	− 2·5	+ 0·6	+ 1·06	βChamæleontis, βHydri W.	12 11	1 56·10	0·170	0·17
„ 31	3	W.	− 2·8	[+ 0·8]	[+ 1·7]		11 30	2 0·10	0·172	0·17
June 1	5	W.	− 2·0	[+ 0·9]	+ 2·37	β Chamæleontis, β Hydri	12 23	2 4·12	0.162	0·19
„ 2	4	W.	− 2·4	[+ 1·1]	[+ 2·3]		12 0	2 9·48	0·227	0·23
„ 3	5	W.	− 1·5	[+ 1·2]	+ 2·31	β Chamæleontis, β Hydri	12 11	2 15·06	0·231	0·23
„ 5	5	W.	− 2·1	[+ 1·5]	+ 2.29	β Chamæleontis, β Hydri	12 27	2 26·35	0·234	0·22
„ 7	6	W.E.	− 3·0	+ 1·8	+ 0·73	βChamæleontis, βHydri W.	12 46	2 35·95	0·199	0·25
„ 8	5	E.	− 2·6	[+ 1·7]	+ 6·00	β Chamæleontis, β Hydri	11 35	2 42·12	0·270	0·26
„ 12	3	E.	− 1·6	[+ 1·1]	+ 6·35	β Chamæleontis, β Hydri	12 30	3 1·46	0·200	0 22
„ 13	6	E.W.	− 2·0	+ 1·0	+ 3·24	βChamæleontis, βHydri E.	12 40	3 6·86	0·223	0·22
July 26	6	W.E.	{ +11·2 + 2·6 }	+ 2·0	+ 2·50	ρ Octantis, α Cor. Bor. E.	15 15	6 26·12	0·213	0·20
Aug. 26	6	E.W.	+ 5·4	+ 0·4	− 1·63	δ[1] Apodis, τ Herculis, E.	17 38	8 41·62	0·182	0·13
„ 27	4	W.	+ 4·5	[+ 0·5]	[− 0·9]		18 25	8 44·82	0·129	0·14
„ 28	5	W.	+ 5·5	[+ 0·6]	− 0·24	δ[1] Apodis, τ Herculis	17 9	8 48·21	0·149	0·15

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1901.			"	"	"		H. M.	M. S.	S.	S.
Aug. 29	5	W.	+ 4·5	[+ 0·7]	+ 0·12	δ^1 Apodis, τ Herculis	17 9	8 51·91	0·154	0·16
Sept. 1	2	W.	+ 4·2	[+ 1·1]	[+ 0.3]		21 15	9 4·25	0·162	0·14
„ 2	7	W.E.	+ 3·6	+ 1·2	+ 1·06 - 0·36	δ^1 Apodis, β Herculis, W. β Herculis, α Tri. Aust. W	17 8	9 6.84	0·130	0·15
„ 3	3	E.	+ 3·1	[+ 1·1]	[+ 1·5]		16 21	9 10·84	0·172	0·21
„ 4	5	E.	+ 2·5	[+ 0·9]	+ 2·66	σ Octantis	16 57	9 16·82	0·243	0·25
„ 5	5	E.	+ 3·1	[+ 0·8]	+ 1·69	σ Octantis	17 8	9 23·10	0·260	0·25
„ 6	4	E.	+ 3·5	[+ 0·7]	+ 0·79	α Tri. Aust., κ Ophiuchi	17 36	9 28·95	0·239	0·23
„ 7	3	E.	+ 3·4	[+ 0 5]	[+ 0·5]		18 19	9 34·54	0·226	0·22
„ 8	5	E.W.	+ 1·9	+ 0·4	+ 0·56 + 0·25	σ Octantis, E. γ Aquilæ, ϵ Pavonis, W	19 34	9 39·97	0·215	
Oct. 23	7	W.E.	+ 1·9	+ 1·6	+ 0·51	λ^1 Octantis, 16 Pegasi, W.	21 37	0 5·76		
„ 25	3	E.	+ 2·4	[+ 1·1]	[+ 1·5]		21 29	0 16·14	0·217	0·17
„ 26	4	E.	+ 1·0	[+ 0·9]	+ 1·99	λ^1 Octantis, γ Aquarii	23 59	0 20·17	0·152	0·17
„ 28	4	E.	+ 3·2	[+ 0·4]	+ 1·39	λ^1 Octantis, 16 Pegasi	21 26	0 29·62	0·208	0·25
„ 29	5	E.W.	+ 2·0	+ 0 2	+ 1·02	β Octantis, λ Pegasi, W.	22 34	0 36 49	0·273	0·27
„ 31	5	W.	+ 2·5	[+ 0·3]	– 0·16	λ^1 Octantis, 16 Pegasi	21 56	0 48·86	0·261	0·24
Nov. 1	5	W.	+ 2·8	[+ 0·4]	+ 0·91	υ Octantis, α Lacertæ	22 3	0 54·36	0·228	0·22
„ 2	2	W.	+ 0·9	[+ 0·4]	[+ 1 2]		23 30	0 59·65	0·208	0·22
„ 3	2	W.	+ 0·5	[+ 0·5]	[+ 1·5]		22 52	1 5·19	0·237	0·23
„ 5	3	W.	+ 2·5	[+ 0·6]	+ 2·05	π^2 Pegasi, υ Octantis	21 59	1 15·55	0·220	0·22
„ 6	5	W.E.	+ 0·6	+ 0·6	[+ 1·6]		23 3	1 21·19	0·225	0·23
„ 7	6	E.	– 0·5	[+ 0·5]	+ 1·09	υ Octantis, α Lacertæ	22 21	1 26·64	0·234	0·24

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer. H.	M.	Chronometer Fast on Sidereal Time at Mean of Transits. M.	S.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1901.			"	"	"		H.	M.	M.	S.	S.	S.
Nov. 8	5	E.	− 1·1	[+ 0·5]	− 0·01	υ Octantis, α Lacertæ	22	4	1	32·23	0·236	0·24
„ 9	5	E.	− 0·6	[+ 0·5]	− 0·24	υ Octantis, α Lacertæ	22	24	1	38·29	0·249	0·25
„ 10	5	E.W.	− 0·7	+ 0·4	− 0·49	υ Octantis, α Lacertæ, E.	22	20	1	44·49	0·259	0·25
„ 18	4	W.E.	− 0·8	+ 0·4	+ 0·82	β Octantis, o Androm, W.	23	46	2	26·09	0·215	0·18
„ 19	3	E.	− 1·3	[+ 0·3]	[+ 0·7]		22	52	2	30·50	0·171	0·18
„ 20	2	E.	− 0·5	[+ 0·1]	[+ 0·5]		22	53	2	34·46	0·184	0·17
„ 21	5	E.	+ 1·6	[0·0]	+ 0·36	κ Tucanæ, υ Andromedæ	1	27	2	38·76	0·162	0·17
„ 22	5	E.	+ 1·2	[− 0·1]	− 0·36	κ Tucanæ, υ Andromedæ	1	10	2	42·77	0·169	0·16
„ 23	1	E.	+ 2·4	[− 0·3]	− 0·91	β Andromedæ, κ Tucanæ	1	7	2	46·39	0·151	0·16
„ 24	6	E.W.	+ 1·5	− 0·4	− 1·62	λ Androm., γ^1 Octantis, E.	0	24	2	50·32	0·169	0·16
„ 25	4	W.	+ 1·4	[− 0·3]	[− 1·6]		1	42	2	54·04	0·147	0·15
Dec. 18	6	W.E.	+ 9·6	+ 1·4	− 1·50	β Androm., κ Tucanæ, W.	1	35	4	44·00	0·199	0·23
„ 19	3	E.	+11·1	[+ 1·2]	− 2·46	κ Tucanæ, η Piscium	1	32	4	49·64	0·235	0·24
„ 22	5	E.	+10·7	[+ 0·6]	− 3·59	μ Hydri, σ Arietis	2	14	5	7·72	0·249	0·25
„ 23	3	E.	+12·8	[+ 0·4]	− 4·86	μ Hydri, σ Arietis	2	29	5	13·82	0·252	0·26
„ 25	6	E.W.	+12·2	0·0	− 6·97	ξ^2 Ceti, μ Hydri, W.	2	5	5	27·03	0·278	0·26
„ 26	3	W.	+13·0	[+ 0·3]	[− 7·0]		2	13	5	33·25	0·258	0·26
„ 27	3	W.	+12·6	[+ 0·6]	[− 7·0]		2	0	5	39·28	0·254	0·25
„ 31	6	W.E.	+11·3	+ 1·8	− 7·14	μ Hydri, σ Arietis, E.	2	31	6	2·18	0·237	

NOTES.

The eastern pivot was raised 65·4″ before the observations of January 29, 23·9″ during those of March 1, and 8·6″ before those of July 26.

The chronometer ran down on April 28 and October 13, and was re-started on May 1 and October 22 respectively.

Extra-Meridian Work.

Planet Observations.—The following differential measures were made with the 8-inch equatorial and its filar-micrometer :—

Planets		Nights of Observation.		Comparisons.		Comparison Stars.
Venus ...	...	4	...	54	...	3
(1) Ceres ...	...	6	...	60	...	2
(11) Parthenope	..	9	...	114	...	5
(18) Melpomene	...	10	...	136	...	5
(78) Diana ...	...	4	...	47	...	2

Two of the stars compared with Venus were the well-known clock stars ψ and h^2 Sagittarii. The resulting places of Venus and Ceres have been kindly compared by Mr. Merfield with the ephemerides of the *Nautical Almanac.* He has also compared the results for Parthenope with the *Berliner Jahrbuch*, and those for Diana with Michajlovski's ephemeris received from the Kasan Observatory. Melpomene was detected and observed with the help of the opposition position given in the *Jahrbuch*, and an approximate ephemeris provided by Mr. Merfield. The results for the planets have been forwarded to the *Astronomische Nachrichten.*

Comet Observations.—On the evening of April 24 I received from the Government Astronomer at Sydney a telegram informing me that a large comet was reported as visible due east a little before sunrise. I had a few glimpses of it on the following morning between clouds, but the weather became so persistently bad that I was unable to get another view of it till the evening of May 3. In consequence of clouds, three hasty comparisons only could be obtained, but the sky for a long period subsequently was, with few interruptions, favourable for observation of the stranger. As the comet was hidden from the large equatorial by the main building of the Observatory, the 4½-inch equatorial and square bar micrometer were employed till May 19, when observations were commenced with the large instrument and continued till June 13. The comet then became faint in the strong twilight. The comet's places were obtained on 32 evenings, the number of comparisons being 273, and of the comparison stars 39. The complete results have already appeared in the *Astronomische Nachrichten.*

Encke's comet was unsuccessfully sought for in the strong twilight on October 2 and 8.

Double-Star Observations.—Twenty evenings have been devoted to this work, during which measures have been taken of twenty-eight pairs of southern double stars, comprising 535 settings for position angle and 276 double settings for distance. The measures have been reduced and sent to the Royal Astronomical Society.

Meteorological Observations.

The following table exhibits the meteorological results for 1901, obtained in the same way as the corresponding values for 1898, 1899, and 1900. The comparisons of thermometers in the Greenwich and Stevenson's stands referred to in the last Report have not yet been completed.

1901.	Temperatures.				Rainfall.			
	Highest Shade.	Lowest Shade.	Highest in Sun, Black Bulb in Vacuo.	Lowest Radiation on Grass.	Gauge 6·8 feet above Ground.	Gauge 32 feet above Ground.	Greatest Daily Fall by Lower Gauge.	Date 9h. a.m.
	°	°	°	°	Inches	Inches	Inches	
January	102·9	50·3	151 0	46·3	2·823	2·613	1·052	28
February	113·4	49·7	161·3	46·2	1·359	1·126	0·864	16
March..	106 1	47·0	151·5	42.6	3·424	3 328	1·260	21
April	94·9	39.8	138 1	36·8	2 570	2·369	0 570	29
May	83·1	30·9	128·7	28·3	0·569	0·537	0·259	28
June	74·4	26·0	113·5	23·4	0·598	0·510	0·239	11
July	73 9	25·9	120·0	23·1	0·745	0·698	0 320	25
August	82·1	27·1	128·7	24·8	2·435	2·287	—	—
September	94·6	35·7	139·2	33 3	1·183	1·151	—	—
October	100 2	40 5	149·3	37·6	1·275	1·184	0·359	28
November	104·0	45·8	153·4	41·9	1·014	0·921	0·400	6
December	110·2	47·5	158·2	43·1	0·476	0.473	0·319	1
Year	113·4	25·9	161·3	23·1	18·471	17·097	1·260	March 21

Note.—The year was, as regards rainfall, the driest but one since 1862. The year characterized by the least rainfall was 1888, when 17·640 inches were recorded by the gauge 6·8 feet above ground. The River and its tributary, the South Creek, were observed to be disturbed on three occasions only during 1901. Slight freshes occurred about January 22, during the latter half of March, and towards the close of August.

Publications.

The following papers have appeared in the principal astronomical journals since the issue of the last Annual Report:—

OBSERVATIONS OF THE OCCULTATION OF JUPITER AND HIS SATELLITES, 1900, September 29.—*Royal Astronomical Society's Monthly Notices*, Vol. LXI., p. 379.

RESULTS OF DOUBLE-STAR MEASURES WITH THE 8-INCH EQUATORIAL IN THE YEARS 1899 AND 1900.—*R.A.S. Monthly Notices*, Vol. LXI., p. 501.

OBSERVATIONS OF COMET 1901, I.; 1901, May 3 to May 9.—*Astronomische Nachrichten*, Band CLVI., p. 95.

OBSERVATIONS OF JUPITER, CERES, JUNO, AND HEBE IN 1900, AND DIANA IN 1901.—*Ast. Nachrichten*, Band CLVI., p. 105.

FURTHER OBSERVATIONS OF COMET 1901, I.; 1901, May 10 to June 13.—*Ast. Nachrichten*, Band CLVII., p. 187.

Observations Recently Utilised.

It is gratifying to find that the following observations have been fully utilised since the publication of the last Report:—

Observations of Comet 1894 II. (Gale), *Ast. Nach.*, Band CXXXV., p. 261, and Band CXXXVI., p. 241. See "Definitive Investigation of the Orbit of Comet 1894, II.," by Henry A. Peck, in the *Astronomical Journal*, Vol. XXI., Nos. 16-17, 1901, April 29.

Observations of Comet 1897, I. (Perrine), *Ast. Nach.*, Band CXLIII., p. 303, and Band CXLIV., p. 79. See "Bestimmung der Bahn des Cometen 1897, I.," von Dr. Johannes Möller.

Observations of Comet 1899, I. (Swift), *Ast. Nach.*, Band CL., p. 45, and Band CLI., p. 277. See "Definitive Orbit-Elements of Comet 1899, I.," by C. J. Merfield, F.R.A.S., *Ast. Nach.*, Band CLVII., p. 33.

The eclipses of Jupiter's Satellites, observed in 1895 and 1896 (*R.A.S. Monthly Notices*, Vol. LV., p. 517, and Vol. LVII., p. 26), respectively have also proved useful, in combination with other

similar data, for determining the longitudes of Nansen's ship "Fram" during her drift through the ice near the North Pole. See *Norwegian North Polar Expedition*, 1893-1896, Part VI., Ast. Obs, reduced by Dr. H. Geelmuyden.

The comparisons of the variable star *R* Carinæ, 1880-1890, have also been of great service for an investigation by A. W. Roberts, D.SC., of the secular variations in the period of this star. See *R.A.S. Monthly Notices*, Vol. LXI., p. 553.

The Library.

It is also a subject for gratification that the donations to the Library during the past year show a large increase both in number and importance. The usual acknowledgments of the receipt of donations is given at the close of the Report. It appears from the list that 64 public institutions and 19 individuals have contributed during the past year. The Author again desires to express his gratitude for so many tokens of sympathy with his work.

Conclusion.

All the observations and reductions, both astronomical and meteorological, have been made by the Proprietor. In this connection he desires to express his thanks to Mr. C. J. Merfield, of Sydney, F.R.A.S., for his kindness in comparing the planet observations with the ephemerides, and also in preparing the logarithms for parallax in connection with the observations of the Great Comet of the year. In consequence of the Author's advancing years, it is probable that there will be a considerable relaxation in his efforts for the year 1902.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1901.

[The names of the Donors are printed in italics]

Results of Rain, River, and Evaporation Observations in New South Wales in 1898, with maps and diagrams; pp. lv. and 235.
Results of Meteorological Observations in New South Wales in 1898; pp. 72.
Current Papers, No. 5, by H. C. Russell, B.A., &c.; pp. 12, with diagrams. *The Government Observatory, Sydney.*

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory and Other Places in Victoria; 1900, Jan. 1 to June 30, pp. 47; and 1900, July 1 to Dec. 31, pp. 48.
Thirty-fifth Annual Report of the Melbourne Observatory; 1900, April 1, to 1901, March 31; pp. 10.
The Government Observatory, Melbourne.

Meteorological Observations at Adelaide Observatory and Other Places in South Australia in 1898; pp. xiv., 81, with maps.
The Government Observatory, Adelaide.

The Climate of Western Australia, from Meteorological Observations in 1876-99; pp. 128, with diagrams.
Meteorological Observations at Perth Observatory and Other Places in Western Australia in 1899.
The Government Observatory, Perth, W.A.

The Surveyor for 1901—Jan. 31, Feb. 28, March 30, May 22, Oct. 15, Nov. 12. *The Institution of Surveyors, N. S. Wales.*

Report of the Council, 16th Session, 1900-1901; pp. 10.
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„ „ No. VIII. Index to Observations of Variable Stars; pp. 215–257.

„ „ No. IX. Meridian Circle Observations of Close Circumpolar Stars; pp. 259–284.

„ XXIII. Part I. Discussion of Observations with Meridian Photometer, 1882–88; pp. 136.

„ XXIV. Results of Observations with Meridian Photometer, 1882–88; pp. 266.

„ XXV. Comparison of Positions of Stars, Dec. + 49° 50′ to + 55° 10′, observed with the Meridian Circle in 1870–84; pp. xix., 382.

„ XXVI. Part I. Preparation and Discussion of the Draper Catalogue; pp. xxiv., 192.

„ XXVII. The Draper Catalogue of Stellar Spectra; pp. iv., 388.

„ XXIX. No. II. Longitude of Smith College Observatory; pp. 35–63.

„ „ No. III. Photometric Observations of Asteroids; pp. 65–88.

„ „ No. IV. Observations of Variable Stars; pp. 89–170.

„ „ No. V. Magnitudes of Bright Stars North of Dec. + 70°; pp. 171–184.

„ „ No. VI. Relative Places of β Persei and Comparison Stars; pp. 185–223.

„ „ Appendix. Comparison of Results of Photometric Observations of Asteroids; pp. 225–227.

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Memoire sur la Latitude de l'Observatoire de Genève, par J. Pidoux; pp. 68. *The Geneva Observatory.*

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L'Eclipse Totale de Soleil de 28 Mai, 1900, par R. Gautier, A. Riggenbach, et A. Wolfer; pp. 33, with plate. *The Auth rs.*

Die Meteorologie der Sonne, &c., von Prof. K. W. Zenger; pp. xxiii., 80. *The Author.*

ERRATA.

Report for 1899.

Page 25, 7th line from bottom, *dele* "von" before G. Schiaparelli.

Report for 1900.

Page	3,	3rd line from bottom,		*insert* " – " before 19·014s.
,,	4,	5th ,,	,,	*for* "ascension" *read* "ascensions."
,,	8,	5th ,,	,,	*for* " λ^1 " *read* " λ."
,,	13,	15th ,,	top,	*for* "ncessary" *read* "necessary."
,,	14,	12th ,,	,,	*for* "Twenty" *read* "Thirty."
,,	18,	28th ,,	,,	*for* "Giguno" *read* "Giugno."

The Ann Arbor Observatory
Ann Arbor.
Michigan.
U.S.A.

REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1902,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, and the British Astronomical Association.

Corresponding Member of the Alliance Scientifique Universelle of Paris, of the Queensland Branch of the Royal Geographical Society of Australasia, and of the Sociedad Cientifica "Antonio Alsate" of Mexico.

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1903.

CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY,

For 1902.

It will be seen from the following Report that a fair amount of work was done during the year 1902.

Position of the Observatory.

Nothing further has been done in the way of determining the position of the Observatory. The co-ordinates are therefore still adopted as:—

Longitude = 10h. 3m. 20·5s. E. of Greenwich.

Astronomical latitude = $-33° 36' 30{\cdot}8''$

Height of the barometer cistern above the local mean tidal level = 52 feet.

Meridian Work.

The chronometer *John Poole*, 2962, was employed throughout, and was regulated by means of the Cooke and Sons 3-inch transit instrument. In the Reports for 1888, 1889, and 1890, will be found an explanation of the methods employed in the transit observations and their reductions. The equatorial distances in sidereal time of the outer wires of the transit instrument from the middle wire, as derived from all the transits of circumpolar stars in 1901, were:—

$$A = +20{\cdot}191\text{s.},\ B = +10{\cdot}488\text{s.},\ C = -9{\cdot}322\text{s.},\ D = -19{\cdot}000\text{s.},$$

with a reduction of 0·471s. to the middle wire when all five wires were observed, and these values were employed during 1902. A re-determination of the values from all the transits of circumpolar stars during the year 1902 gives the following:—

$$A = +20{\cdot}197\text{s.},\ B = +10{\cdot}516\text{s.},\ C = -9{\cdot}323\text{s.},\ D = -19{\cdot}006\text{s.},$$

with a reduction of $+0{\cdot}477$s. to the middle wire.

The following is a summary of the meridian work for 1902:—

Nights on which the local time was determined		103
Transits observed of stars with a declination not exceeding 40°		422
Transits of stars of high declination observed for azimuth ...		91
Separate determinations of	level error	277
	collimation error	29
	azimuth error	68

The table which follows shows the errors of the transit instrument, and the errors and rates of the chronometer *John Poole*, which was also always employed in the extra-meridian department. The year was, as regards rainfall, the driest recorded here since the establishment of the meteorological department at the close of 1862. The disturbances of the level error were therefore not so great as in former years. The places of the clock and azimuth stars have been taken throughout from the *American Ephemeris*.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—1902.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1902.			″	″	″		H. M.	M. S.	S.	S.
Jan. 28	7	E.W.	+ 6·8	0·0	− 8·17	η Tauri, γ Hydri E.	4 22	8 17·55		
Feb. 1	2	W.	+ 5·0	[+0·1]	[− 8·4]		4 43	8 38·17	0·214	0·20
„ 8	2	W.	+ 5·8	[+0·1]	[− 8·7]		4 31	9 9·07	0·184	0·20
„ 14	2	W.	+ 6·6	[+0·1]	[− 8·9]		5 33	9 40·25	0·215	0·21
„ 19	1	W.	+ 5·7	[+0·1]	[− 9·1]		6 12	10 6·10	0·214	0·21
„ 25	2	W.	+ 5·6	[+0·2]	[− 9·4]		5 57	10 34·99	0·201	0·24
Mar. 1	2	W.	+ 5·3	[+0·2]	[− 9·5]		8 14	11 1·53	0·270	0·26
„ 13	2	W.	+ 3·3	[+0·3]	[−10·1]		8 21	12 5·95	0·223	0·15
„ 16	1	W.	− 0·1	[+0·3]	[−10·2]		6 2	12 15·39	0·136	0·15
„ 24	6	W.E.	− 2·3	+0·4	−10·60	ζ Geminorum, γ^2 Piscis Vol. W.	7 49	12 51·42	0·186	0·20
April 21	5	E.W.	−10·4	+0·6	− 9·12	κ Cancri, β Argûs E.	10 27	15 32·97	0·239	0·22
May 14	3	W.	{−18·4 − 0·6}	[+0·8]	[− 9·4]		7 11	17 27·85	0·209	0·23
„ 21	5	W.E.	{− 0·6 − 5·6}	+0·8	− 9·52	η Octantis, ν Ursæ Majoris W.	12 27	18 9·38	0·240	0·25
„ 24	3	E.	− 4·0	[+0·8]	[− 9·5]		14 24	18 28·60	0·260	0·25
„ 29	3	E.	− 2·5	[+0·7]	[− 9·6]		7 12	18 54·35	0·228	0·22
June 16	6	E.W.	− 3·1	+0·6	− 9·98	δ Muscæ, ζ Virginis E.	13 59	20 28·19	0·214	0·25
„ 18	2	W.	− 3·0	[+0·5]	[− 9·8]		13 13	20 40·15	0·253	0·27
„ 19	2	W.	− 3·1	[+0·4]	[− 9·6]		10 30	20 46·22	0·285	0·28
„ 20	3	W.	− 2·1	[+0·3]	− 9·45	κ Octantis, η Ursæ Majoris	14 12	20 53·83	0·275	0·27
„ 28	2	W.	− 2·7	[−0·4]	[−10·8]		10 31	21 49·67	0·273	0·27
„ 29	4	W.	− 1·9	[−0·3]	[−11·0]		20 16	21 58·62	0·265	0·26

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1902.							H. M.	M. S.	S.	S.
July 1	2	W.	– 3″·3	[– 0″·5]	[– 11″·3]		11 34	22 8·70	0·256	0·26
„ 3	6	W.E.	– 2·0	– 0·6	– 11·61	ρ Bootis, α Apodis W.	15 51	22 22·36	0·261	0·26
„ 11	2	E.	– 1·2	[0 0]	[– 9·3]		19 34	23 10·05	0·244	0·22
„ 14	2	E.	– 0·9	[+0·1]	[– 8·4]		15 28	23 24·17	0·208	0·22
„ 15	2	E.W.	– 1·5	+0·2	– 8·19	η Bootis, δ Octantis E.	14 19	23 29·16	0·218	0·20
„ 16	4	W.	– 2·1	[+0·4]	– 12·10	δ Octantis, ρ Bootis	14 57	23 33·61	0·181	0·20
„ 17	6	W.	– 2·3	[+0 5]	– 12·80	ρ Bootis, α Apodis	12 21	23 38·47	0·227	0·24
„ 18	5	W.	– 2·3	[+0·7]	– 10·99	δ Octantis, θ Bootis	12 18	23 44·29	0·243	0·24
„ 20	4	W.	– 1·7	[+1·0]	– 10·94	δ Octantis, θ Bootis	12 31	23 56·02	0·243	0·25
„ 21	6	W.E.	– 3·7	+1·2	– 8·31	ρ Bootis, α Apodis E.	13 23	24 2 14	0·246	0·24
„ 22	5	E.	– 3·0	[+1 0]	– 8·70	ρ Bootis, α Apodis	13 45	24 7·69	0·228	0·25
„ 23	2	E.	– 3·0	[+0·9]	[– 8·8]		13 49	24 14·41	0·279	0·27
„ 24	4	E.	– 3·7	[+0·7]	– 8·96	ρ Bootis, α Apodis	14 8	24 20·84	0·264	0·27
„ 25	6	E.	– 3·9	[+0·6]	– 9·18	ρ Bootis, α Apodis	13 12	24 27·29	0·280	0·27
„ 26	...	E.W.	...	+0·4	...					
„ 27	5	W.	– 4·3	[+0·4]	– 11·77	δ Octantis, θ Bootis	12 52	24 38·61	0·237	0·19
„ 28	5	W.	– 4·2	[+0·4]	– 10 84	δ Octantis, θ Bootis	13 55	24 42 87	0·170	0·20
„ 29	5	W.	– 3·8	[+0 6]	– 10·73	δ Octantis, θ Bootis	13 18	24 48·06	0·222	0·24
„ 30	5	W.E.	– 4·0	+0·6	– 9 60	δ Octantis, θ Bootis W.	14 46	24 54·52	0·254	0 29
„ 31	4	E.	+0·2	[+0 8]	– 8 43	δ Octantis, θ Bootis	14 24	25 2 25	0·327	0·34
Aug. 1	6	E.	– 0·1	[+1·1]	– 8·02	δ Octantis, θ Bootis	14 6	25 10·51	0·349	0·35
„ 2	5	E.	– 0·1	[+1 3]	– 7 20	δ Octantis, θ Bootis	13 46	25 18·77	0·349	0·35
„ 3	2	E.	0·0	[+1·6]	[– 6·7]		13 34	25 27·27	0·357	0·35

Instrumental Errors and Chronometer Errors and Rates—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Collimation.	Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.		Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1902.			″	″	″		H. M.	M.	S.	S.	S.
Aug. 4	5	E.W.	−0·3	+1·8	−6·24	ρ Bootis, α Apodis W.	14 23	25	35·88	0·347	0·35
„ 5	3	W.	−1·5	[+1·6]	[−6·6]		14 29	25	43·51	0·317	0·33
„ 6	5	W.	−1·9	[+1·5]	−6·97	α Apodis, β Bootis	14 27	25	51·83	0·347	0·33
„ 7	4	W.	−1·8	[+1·3]	[−7·6]		14 12	26	0·05	0·346	0·32
„ 8	3	W.	+0·5	[+1·2]	[−8·2]		15 6	26	7·52	0·300	0·30
„ 9	7	W.E.	−1·0	+1·0	−8·76	ρ Octantis, α Serpentis W.	15 39	26	14·63	0·290	0·27
„ 10	4	E.	−1·4	[+1·1]	−6·69	δ Bootis, ρ Octantis	15 50	26	20·50	0·243	0·24
„ 12	5	E.	−0·9	[+1·4]	−6·74	δ Bootis, ρ Octantis	14 33	26	31·82	0·242	0·28
„ 13	3	E.	−0·7	[+1·5]	[−6·6]		19 53	26	40·59	0·299	0·28
„ 15	3	E.	−2·1	[+1·8]	[−6·3]		18 35	26	52·45	0·254	0·21
„ 16	3	E.	+0·3	[+1·9]	−6·16	σ Octantis, δ Aquilæ	19 58	26	57·30	0·191	0·19
„ 17	5	E.W.	{−0·1 −3·2}	+2·0	−6·25	1 Aquilæ, σ Octantis E.	19 38	27	1·95	0·196	0·19
„ 18	4	W.	−1·7	[+2·0]	−8·28	ε Pavonis, γ Sagittæ	20 8	27	6·39	0·181	0·19
„ 19	5	W.	−1·6	[+2·0]	−8·86	σ Octantis, θ Lyræ	18 22	27	10·84	0·200	0·20
„ 23	7	W.E.	−1·8	+2·0	−9·10	σ Octantis, θ Lyræ W.	19 49	27	28·76	0·184	0·21
„ 25	5	E.	−2·6	[+1·8]	−6·88	σ Octantis, θ Lyræ	19 24	27	39·06	0·216	0·20
„ 28	3	E.	−3·2	[+1·4]	[−7·0]		17 40	27	51·57	0·178	0·16
Sept. 1	6	E.W.	−2·9	+1·0	−7·08	σ Octantis, θ Lyræ W.	18 44	28	4·09	0·129	0·15
„ 15	6	W.E.	−2·5	+0·8	−5·86	σ Octantis, θ Lyræ W.	19 55	29	25·48	0·241	0·31
„ 16	1	E.	−0·3	[+0·8]	[−5·9]		20 1	29	32·97	0·311	0·30
„ 17	4	E.	−2·8	[+0·9]	−5·95	σ Octantis, θ Lyræ	19 54	29	39·69	0·281	0·28
„ 18	4	E.	−2·2	[+0·9]	−4·08	β Sagittæ, ε Pavonis	20 16	29	46·69	0·287	0·29

Instrumental Errors and Chronometer Errors and Rates—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1902.							H. M.	M. S.	S.	S.
Sept. 20	3	E.	− 3″·6	[+1″·0]	− 4″·33	1 Pegasi, λ^1 Octantis	21 48	30 2·03	0·310	0·31
„ 21	6	E.W.	− 3·2	+1·0	− 5·31	β Lyræ, σ Octantis E.	20 1	30 8·83	0·306	0·30
Oct. 1	4	W.	− 4·9	[+1·8]	[− 5·5]		20 48	31 3·95	0·229	0·16
„ 3	6	W.E.	− 4·3	+2·0	− 5·49	δ Cygni, ϵ Pavonis W.	20 28	31 11·09	0·150	0·18
„ 5	4	E.	− 5·7	[+1·7]	[− 5·1]		20 55	31 21·29	0·211	0·22
„ 6	1	E.	− 4·9	[+1·6]	[− 4·8]		21 7	31 26·60	0·219	0·21
„ 7	2	E.	− 3·7	[+1·4]	[− 4·6]		21 3	31 31·52	0·206	0·23
„ 8	4	E.	− 2·9	[+1·3]	− 4·40	δ Cygni, ϵ Pavonis	20 50	31 37·32	0·244	0·24
„ 9	3	E.	− 3·2	[+1·3]	− 3·65	ϵ Pavonis, γ Sagittæ	20 6	31 42·99	0·244	0·23
„ 10	5	E.W.	− 4·7	+1·2	− 4·26	α Lacertæ, β Octantis W.	22 37	31 48·59	0·211	0·22
„ 11	3	W.	− 4·2	[+1·3]	− 7·37	λ^1 Octantis, α Aquarii	22 25	31 54·13	0·233	0·24
„ 13	5	W.	− 5·1	[+1·6]	− 5·19	π^2 Pegasi, υ Octantis	21 24	32 5·56	0·243	0·22
„ 15	3	W.	− 4·3	[+1·9]	− 5·22	λ^1 Octantis, π^2 Cygni	21 45	32 14·64	0·188	0·23
„ 16	7	W.E.	− 5·6	+2·0	− 5·90	λ^1 Octantis, π^2 Cygni W.	22 53	32 21·05	0·255	0·24
„ 17	4	E.	− 6·0	[+1·9]	− 4·97	ι Piscium, γ^1 Octantis	23 53	32 26·83	0·231	0·22
„ 20	5	E.	− 7·1	[+1·6]	− 5·94	λ^1 Octantis, π^2 Cygni	21 54	32 41·11	0·204	0·19
„ 21	4	E.	− 7·7	[+1·5]	− 4·57	λ^1 Octantis, π^2 Cygni	21 47	32 45·54	0·186	0·17
„ 22	6	E.W.	− 7·5	+1·4	− 5·66	λ^1 Octantis, α Aquarii W.	21 49	32 49·38	0·160	0·16
Nov. 4	3	W.	− 8·4	[+2·3]	− 6·09	λ Andromedæ, γ^1 Octantis	0 20	33 46·86	0·183	0·14
„ 5	5	W.E.	− 9·4	+2·4	− 3·75	γ^1 Octantis, α Andromedæ E.	0 23	33 50·25	0·141	0·12
„ 6	5	E.	− 9·4	[+2·1]	− 4·72	λ Andromedæ, γ^1 Octantis	23 54	33 52·69	0·104	0·11
„ 8	1	E.W.	− 9·6	+1·4	[− 4·4]		22 45	33 58·05	0·114	0·12
„ 11	4	W.	− 9·9	[+1·7]	− 3·84	γ^1 Octantis, α Andromedæ	0 31	34 8·01	0·135	0·17

Instrumental Errors and Chronometer Errors and Rates—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1902.			"	"	"		H. M.	M. S.	S.	S.
Nov. 15	6	W.E.	− 8·5	+2·0	− 4·99	λ Andromedæ, γ^1 Octantis W.	0 27	34 28·95	0·218	0·21
Dec. 2	6	E.W.	−12·5	+1·6	− 3 17	β Chamæleontis, β Hydri E.	0 59	35 44·26	0·184	0·14
„ 4	3	W.	−12·2	[+1·6]	[− 3 0]		2 7	35 50 68	0·131	0·13
„ 10	6	W.E	−14·7	+1·4	− 2·63	β Hydri, π Andromedæ W.	1 26	36 9 99	0·135	0·12
„ 13	4	E.	−16·3	[+1·3]	− 3·02 − 3·37	η Tauri, γ Hydri δ Persei, γ Hydri	3 48	36 18·12	0·109	0·10
„ 18	2	E.	−13·9	[+1·0]	[− 1·9]		1 59	36 28·56	0·089	0 07
„ 19	6	E.W.	−12·8	+1·0	[− 1·6]		1 53	36 30·21	0·069	0·11
„ 20	5	W.	−11·8	[+1·0]	− 1·29	η Tauri, γ Hydri	2 16	36 33·75	0·145	0·17
„ 21	5	W.	−11·1	[+1·1]	+ 3·91	β Andromedæ, κ Tucanæ	1 42	36 38·22	0·191	0·18
„ 23	5	W.	−11·9	[+1·2]	+ 3·80	β Andromedæ, κ Tucanæ	2 0	36 45·28	0·146	0·13
„ 24	5	W.E.	−10·1	+1·2	[+ 0·4]		2 28	36 48·10	0·115	0·13
„ 25	6	E.	− 9·5	[+1·2]	− 2·93	η Tauri, γ Hydri	2 24	36 51·77	0·153	0·18
„ 26	7	E.	− 9·8	[+1·3]	− 0·18	η Tauri, γ Hydri	2 29	36 56·78	0·208	0·18
„ 27	5	E.	− 9·8	[+1·3]	− 0·71	η Tauri, γ Hydri	3 6	37 0 30	0·143	0·16
„ 30	5	E.	−10·2	[+1·4]	+ 1·30	γ Hydri, A^1 Tauri	2 43	37 14·37	0·196	
„ 31	...	E.W.	−11·8	+1·4	...					

NOTES.

The eastern pivot was lowered before the observations of May 14.

The level error was changed by the reversal of the instrument on May 21 and August 17.

Transits could not be observed with the clamp west on November 8.

Extra-Meridian Work.

Planet Observations.—The following micrometer comparisons were made with the 8-inch equatorial.

Planet.	Nights of Observation.	Number of Comparisons.	Number of Comparison Stars.
(2) Pallas	11 ...	134 ...	4
(4) Vesta	13 ...	124 ...	6
(8) Flora	17 ...	176 ...	10
(42) Isis	25 ...	270 ...	16
(164) Eva	7 ...	65 ...	7

The results have been sent to the *Astronomische Nachrichten*. Mr. C. J. Merfield, F.R.A.S., has kindly compared the places of Pallas, Vesta, Isis, and Eva with the ephemerides, but in the case of Flora no ephemeris has yet been published. The planet was found by means of the approximate opposition-position and daily motion given in the *Berliner Astronomische Jahrbuch*. Mr. Merfield has also kindly supplied the logarithms of $p\Delta$ for the observed places of Vesta, Isis, and Eva.

Comet Observations.—The earliest announcement received here of Comet *b* 1902 (Perrine) was by Bulletin No. 22 of the Lick Observatory on October 16, but in consequence of my being prostrated by a severe attack of influenza, I could not take part in the work of observation till the evening of November 4. The comet was observed with the 4½-inch equatorial on that date and the 6th. With the aid of Professor Nijland's ephemeris in No. 3817 of the *Astronomische Nachrichten*, I readily found the comet on the 10th. in the bright band of sky along the western horizon, but search was made in vain for a comparison star. The comet was again seen on the following evening, but quite close to the horizon. After its conjunction with the sun, the comet was again found by means of Dr. Strömgren's ephemeris on the morning of December 24th (civil time), and observed on the 26th, 27th, 28th, and 31st. Altogether the comet's places were obtained on seven dates during the year, the number of comparisons being 50 and the number of comparison stars 10. The observations were, however, continued down to February 16 of the current year, and the complete results have been sent to the *Astronomische Nachrichten*. Mr. Merfield has also kindly supplied the logarithms of $p\Delta$ for the comet places from December 24 to February 16.

Under the head of "New Zealand and a New Comet," appeared in the *Sydney Morning Herald* of July 29, a telegram announcing the

discovery of a faint telescopic comet by Mr. Grigg in the constellation Virgo. The next intimation that I received was from Mr. W. F. Gale, F.R.A.S., of Newcastle, on August 6th, to whom Mr. Grigg had communicated his discovery, but as there were not sufficient data for finding so faint an object, and I was closely engaged in minor planet work, I did not make a search. It is much to be regretted, as I pointed out to Mr. Grigg, that he did not communicate his discovery with approximate positions immediately to the Melbourne Observatory. Had he done so, some good positions might have been secured.

DOUBLE-STAR OBSERVATIONS.—Observations in this department were made on eighty-two different dates. Repeated measures were made of fifty-four pairs of the most interesting stars in Innes' Reference Catalogue. The work comprises 1757 settings for position angle and 1503 for distance. The measures have been reduced and sent to the Royal Astronomical Society. I cannot omit to acknowledge the great assistance I have received in this work from the Catalogue above referred to.

SUNDRY OBSERVATIONS.—These comprise only a few observations of occultation of stars by the moon, and of phenomena of Jupiter's satellites.

Meteorological Observations.

The following is a statement of the meteorological results for 1902:—

1902.	Temperatures.				Rainfall.			
	Highest Shade.	Lowest Shade.	Highest in Sun, Black Bulb in Vacuo.	Lowest Radiation on Grass.	Gauge 6·8 feet above Ground.	Gauge 22·0 feet above Ground.	Greatest Daily Fall by Lower Gauge.	Date 9h. a.m.
	°	°	°	°	Inches	Inches	Inches	
January	110·5	53·2	160·5	46·8	1·560	1·487	0·864	13
February	106·8	49·3	153·7	43·5	0·079	0·086	0·036	4
March	104·6	44·3	149·3	39·3	0·857	0·750	0·320	20
April	94·3	43·6	136·5	35·4	0·717	0·599	0·492	6
May	79·8	32·8	124·0	28·2	0·384	0·355	0·273	1
June	76·2	27·9	117·5	23·1	0·435	0·423	0·260	3
July	78·9	28·5	117·9	23·6	0·707	0·677	0·230	27
August	73·9	25·1	128·0	22·7	1·457	1·389	0·400	28
September	90·9	32·7	135·8	25·8	1·659	1·572	0·885	27
October	96·5	42·1	154·4	37·8	3·169	2·919	0·760	29
November	107·0	42·2	157·8	37·5	2·395	2·226	1·395	9
December	107·3	54·9	157·0	50·5	4·070	3·879	1·026	18
Year	110·5	25·1	160·5	22·7	17·489	16·862	1·395	Nov. 9

The above table exhibits the lowest annual rainfall by the gauge about seven feet above ground since observations were commenced

in the beginning of 1863. The average annual rainfall by this gauge for 40 years is 32·045 inches, and the greatest annual fall was 62·513 inches in 1870. During the year the River and South Creek were disturbed on two occasions only. They rose a few feet about October 22 and December 20. In accordance with the plan proposed in my Report for 1900, I have made a large number of comparisons of two thermometers, one in the Greenwich and the other in the Stevenson's stand. The following table shows the excess of the readings by the former method of exposure.

Temperatures.	Mean Excess.
40° to 50°	$1^\circ \cdot 2$
50 „ 60	0·7
60 „ 70	0·9
70 „ 80	1·7
80 „ 90	1·4
90 „ 100	1·4
100 „ 110	2·5

Further comparisons will be made.

Publications.

The following papers have been published in astronomical journals since the last annual Report.

RESULTS OF DOUBLE-STAR MEASURES WITH THE 8-INCH EQUATORIAL IN 1901.—*Royal Astronomical Society's Monthly Notices*, Vol. LXII., p. 485.

OBSERVATIONS OF VENUS, CERES, PARTHENOPE, AND MELPOMENE IN 1901.—*Astronomische Nachrichten*, Band CLVIII., p 315.

OBSERVATIONS OF COMET *b* 1902 (Perrine) on 1902 November 4 and 6.—*Astronomische Nachrichten*, Band CLX., p. 373.

OBSERVATIONS OF VESTA, FLORA, ISIS, AND EVA IN 1902.—*Astronomische Nachrichten*, Band CLXI., p. 281.

Observations Recently Utilised.

The great Comet of 1901 was observed in the Southern Hemisphere only. The Windsor observations, comprising thirty-two different dates, are utilised in the definitive investigation of the orbit by Mr. C. J. Merfield, F.R.A.S., published in No. 4, Teil II., of *Astronomische Abhandlungen als Ergänzungshefte zu den Astronomischen Nachrichten herausgegeben* von Prof. Dr. H. Kreutz.

The Library.

This important department of the Observatory has been enriched during the year by contributions from 54 public institutions and 12 private individuals. The usual list of contributions will be found in the following pages. The author's thanks are again tendered to the various contributors.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1902.

[NOTE.—The names of the donors are printed in italics.]

Results of Rain, River, and Evaporation Observations in New South Wales in 1899; pp. lx., 251, with maps, etc.
The Government Observatory, Sydney.

Results of Observations in Meteorology and Terrestrial Magnetism at Melbourne Observatory and other places in Victoria, for Half-Years ended 1901, June 30; and 1901, December 31; pp. 48 and 51.

Thirty-sixth Report of the Melbourne Observatory, 1901, April 1, to 1902, March 31; pp. 9. *The Government Observatory, Melbourne.*

Meteorological Observations at Perth Observatory and other places in Western Australia, during 1900; pp. 121, with diagrams.
The Government Observatory, Perth, W.A.

The Surveyor for 1901, Dec. 28; 1902, Jan. 22, Feb. 20, March 17, April 17, May 15, June 13, July 17, Aug. 27, Sept. 24, Oct. 25, Nov. 28. *The Institution of Surveyors, N.S. Wales.*

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The Hawkesbury Agricultural College.

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Summary of the Weekly Weather Report, 1901: Values for the whole year.

Weekly Weather Report, 1901: Rainy Days.

Title Page and Preface of the Weekly Weather Report for 1901; also Appendix III. of the Weekly Weather Report, 1901.

Summary of Observations at Stations in the Daily and Weekly Weather Reports for 1901, Sept., Oct., Nov., and Dec.

Meteorological Observations at Stations of the Second Order for 1898, with map; pp. xiii., 184.

Hourly Means for the Five Observatories under the Meteorological Council, 1898; pp. xi., 239.

Summary of Observations at 114 Stations in the United Kingdom, 1902, January, February, March, April, May, June, July, and at 116 Stations, 1902, August and September.

Temperature Tables for the British Islands, Daily Means for the 30 Years, 1871 – 1900; pp. xiv., 120.
Supplement to same; pp. vii., 35.
Report of the Council to the Royal Society for Year ended 1901, March 31; pp. 162. *The Meteorological Office, London.*

Results of Micrometer Measures of Double-Stars with the 28-inch Refractor at the Royal Observatory, Greenwich, in 1901.
The Royal Observatory, Greenwich.
Results of Astronomical Observations at the Royal Observatory, Greenwich, in 1899.
Greenwich Second Ten Year Catalogue of 6892 Stars for 1900·0; pp. 73, cxl.
Tables to Facilitate the Reduction of Transits at the Royal Observatory, Greenwich; pp. 14.
Results of Meridian Observations of Stars at the Royal Observatory, Cape of Good Hope in 1896 and 1897; pp. 238, with Appendix.
The same in 1898 and 1899; pp. 304.
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The Fernley Observatory, Southport.
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The Temple Observatory, Rugby.
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The Wolsingham Observatory.
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Independent Day Numbers for 1904, as used at the Royal Observatory, Cape of Good Hope, pp. 14.
Report of Her Majesty's Astronomer at the Cape of Good Hope for 1901; pp. 22. *The Royal Observatory, Cape of Good Hope.*

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The Washburn Observatory.

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Observations and Ephemerides of the Variable Star Y *Cygni*, by N. C. Dunér; pp. 149 – 150.

Sur la Deformation des Couches Sensibles des Plaques Photographiques, etc., par O. Bergstrand; pp. 187 – 224.

Sur la Parallaxe d'une Etoile dans le Voisinage de 61 Cygne, par O. Bergstrand; pp. 10. *The Upsal Observatory.*

Preliminary Report of the Dutch Expedition to Karang-Sago, Sumatra, for the Observation of the Total Solar Eclipse of May, 1901; pp. 22.

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Galileo in Arcetri, Discorso Inaugurale, 4 Novembre, 1901, dal Prof. A. Abetti; pp. 41.

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The Oxford Photographic Determinations of Stellar Parallax: Reply to Prof. Turner, by Sir D. Gill; pp. 513 – 521.

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Preliminary Investigation of the Diameter of Mars, by same; pp. 97 – 114.

Micrometrical Measures of the Equatorial Diameter of Saturn and of his System of Rings, by same; pp. 389 – 404.

Observations of the Diameters of the Satellites of Jupiter and of Titan, by same; pp. 325 – 336.

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ERRATA.

Report for 1897.

Page 24,	2nd	line from top—		*for* Skrine *read* Shinn.
,, 24,	8th	,,	,,	*for* Art. *read* Ast.
,, 24,	9th	,,	from bottom—	*for* Rotazioni *read* Rotazione.
,, 24,	8th	,,	,,	*for* topographia *read* topografia.
,, 24,	8th	,,	,,	*for* Quarte *read* Quarta.
,, 24,	5th	,,	,,	*for* ua *read* un.
,, 24,	5th	,,	,,	*for* Metode *read* Metodo.
,, 24,	4th	,,	,,	*for* Flontarino *read* Contarino.

Report for 1899.

Page 23, line 17 from bottom—*for* Bundschau *read* Rundschau.

Report for 1901.

Page 19, line 10 from bottom—*for* Tycho *read* Tychonis.

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REPORT

OF

Mr. Tebbutt's Observatory,

THE PENINSULA,

WINDSOR, NEW SOUTH WALES,

FOR THE YEAR 1903,

BY

JOHN TEBBUTT,

Fellow of the Royal Astronomical Society, London; Member of the Royal Society of New South Wales, and of the British Astronomical Association.

Corresponding Member of the Alliance Scientifique Universelle of Paris, of the Queensland Branch of the Royal Geographical Society of Australasia, and of the Sociedad Cientifica "Antonio Alzate" of Mexico.

SYDNEY:

F. W. WHITE, Printer and Publisher,
344 Kent Street.

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344 KENT STREET.

1904.

CONTENTS.

REPORT

OF THE

WINDSOR OBSERVATORY,

For 1903.

THE following is a Report of the work done during the year 1903.

Buildings and Instruments.

No addition has been made to the buildings or the instruments during the year. In the Report for 1901 will be found a list of all the instruments with which the Observatory is equipped, and for a complete description of them the reader is referred to the History and Description of the Observatory, published at the close of 1887.

Position of the Observatory.

The co-ordinates of the Observatory, and the height of the barometer cistern above the local mean tidal level are :—

Longitude ... ... 10h. 3m. 20·5 secs. E. of Greenwich.
Astronomical latitude ... $-33° 36' 30·8''$
Height of barometer cistern ... 52 feet.

Meridian Work.

The timekeeper employed was the sidereal chronometer *John Poole*, No. 2962, which was regulated by means of the 3-inch transit instrument. An explanation of the methods employed in the reduction of the transit observations will be found in the Reports for 1888, 1889, and 1890. The equatorial distances in sidereal time of the outer wires of the transit instrument from the middle wire, as derived from all the transits of circumpolar stars in 1902, were :—

A = +20·197s., B = +10·516s., D = −9·323s., E. = −19·006s.,

with a reduction of +0·477s. to the middle wire C, when all five wires were observed. These values were employed during 1903. A re-determination of the values from all the transits of circumpolar stars during 1903 gives the following values:—

A = + 20·211s., B = + 10·510s., D = − 9·304s., E = − 19·009s., with a reduction of + 0·482s. to the middle wire.

The following is a summary of the meridian work for 1903 :—

Nights on which the local time was determined		86
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	collimation error	25
	azimuth error	64

It may be mentioned that previously to February 21, the collimation error was determined by comparing the middle wire of the 3-inch transit instrument with that of the 2-inch collimator on a pier a little north of the Observatory in both positions of the rotation axis of the former. The method employed is that described in the Report for 1890. An accident, however, happened to the wires of the collimator on the date above mentioned, so that subsequently the error was deduced from transits of stars of considerable north declination in both positions of the rotation axis. The table following shows the errors of the transit instrument and errors and rates of the chronometer *John Poole* during the year. This chronometer was also always employed in the extra meridian observations. The places of the clock and azimuth stars have been adopted throughout from the *American Ephemeris*.

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—1903.

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1903.							H. M.	M. S.	S.	S.
Jan. 2	5	W.	−11″·1	[+1″·5]	+0″·57	μ Hydri, σ Arietis	3 27	37 27·37		
„ 3	5	W.	−12·5	[+1·5]	−1·27	μ Hydri, σ Arietis	3 15	37 30·43	0·129	
„ 4	3	W.	−12·7	[+1·5]	[−0·8]		4 56	0 2·78		
„ 5	5	W.	−12·9	[+1·6]	−0·25	μ Hydri, σ Arietis	3 3	0 5·05	0·103	0·15
„ 6	5	W.E.	−12·8	+1·6	−1·30	μ Hydri, σ Arietis W.	3 11	0 9·77	0·196	0·23
„ 7	5	E.	−13·2 −2·6	[+1·5]	+0·41	μ Hydri, σ Arietis	2 50	0 16·15	0·270	0·24
„ 8	5	E.	−2·9	[+1·4]	+1·59	μ Hydri, σ Arietis	2 53	0 21·29	0·214	0·21
„ 9	4	E.	−3·7	[+1·2]	+0·98	η Tauri, γ Hydri	3 27	0 26·30	0·204	0·19
„ 10	4	E.	−4·4	[+1·1]	+1·64	η Tauri, γ Hydri	3 27	0 30·29	0·166	0·17
„ 11	...	E.W.	−5·6	+1·0						
„ 19	6	W.E.	−7·7	+1·4	−1·22	β Persei, ι Hydri W.	4 11	1 9·57	0·181	0·11
„ 20	5	E.	−7·4	[+1·4]	−1·65	β Persei, ι Hydri	3 9	1 11·85	0·099	0·11
„ 28	6	E.W.	−5·3	+1·0	−1·24	η Tauri, γ Hydri E.	5 23	1 43·84	0·165	0·16
„ 29	5	W.	−5·3	[+0·8]	−1·42	η Tauri, γ Hydri	4 7	1 47·38	0·156	0·16
„ 30	5	W.	−5·8	[+0·7]	−0·49 −1·62	η Tauri, γ Hydri γ Tauri, δ Mensæ	4 1	1 51·05	0·154	0·14
„ 31	5	W.	−6·8	[+0·5]	−1·24	η Tauri, γ Hydri	4 14	1 54·17	0·129	0·13
Feb. 1	6	W.E.	−6·3	+0·4	+0·31	η Tauri, γ Hydri W.	4 8	1 56·98	0·122	0·12
„ 14	6	E.W.	−2·3	+0·4	−3·41	ψ^5 Aurigæ, ζ Mensæ W.	5 31	2 42·43	0·145	0·15
„ 15	3	W.	+1·8	[+0·5]	[−3·8]		7 35	2 46·45	0·154	0·20
„ 16	3	W.	+3·0	[+0·7]	[−4·2]		5 17	2 51·95	0·253	0·26
„ 17	6	W.E.	+3·6	+0·8	[−4·6]		5 28	2 58·60	0·275	0·27
„ 21	6	E.W.	+2·1	+0·5	−6·10	ζ Mensæ, ζ Geminorum W.	6 23	3 21·40	0·235	0·22
„ 23	3	W.	+3·1	[+0·6]	[−6·0]		8 25	3 32·35	0·219	

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast or Slow on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1903.							H. M.	M. S.	S.	S.
Mar. 22	6	W.E.	− 1″·8	+1″·9	−3″·85	ε Geminorum, ζ Mensæ W.	6 51	0 6·97		
„ 23	2	E.	− 2·1	[+1·8]	[−3 9]		6 25	0 5·04	0·082	
April 13	3	E.	− 6·6	[−1·1]	[−5·3]		10 31	1 7·11	0·142	0·20
„ 14	6	E.W.	− 9 1	−1·2	−5 31	θ Chamæleontis, σ² Cancri E.	9 4	1 11·59	0·199	0·22
„ 15	4	W.	− 6·6	[−1 0]	−1·05	κ Cancri, ζ Chamæleontis	8 47	1 17·15	0·234	0 21
„ 16	4	W	− 8·4	[−0·8]	−1·55	κ Cancri, ζ Chamæleontis	8 49	1 21·63	0·184	0·18
„ 25	6	W.E.	− 9 6	+1·0	−2·43	ρ Leonis, δ² Chamæleontis E.	10 17	1 53·18	0·140	0·14
„ 27	4	E.	− 9·6	[+1·2]	[−2·2]		9 9	1 59·83	0·142	0·17
„ 28	4	E.	− 9·5	[+1 3]	−2·13	β Cancri, θ Chamæleontis	9 23	2 4 27	0·183	0·17
„ 30	2	E.	− 9·8	[+1·5]	[−1·8]		11 13	2 11·41	0·143	0·15
May 2	6	E.W.	−10 3	+1·7	[−1·5]		9 10	2 18·88	0·163	0·15
„ 9	6	W.E.	−10 6	0 0	−0·34	δ² Chamæleontis, δ Leonis W.	11 35	2 37·54	0·109	0·09
„ 10	5	E.	−10·9	[+0·1]	−3·74	η Octantis, δ Leonis	11 27	2 39·66	0 089	0·12
„ 11	4	E.	−10 6	[+0·2]	−1·47	41 Leonis Min., δ² Chamæl.	9 34	2 43 09	0·155	0·17
„ 12	2	E.	−10·6	[+0 4]	[−1·5]		9 12	2 47·44	0·184	0 20
„ 13	5	E.	−10·9	[+0 5]	−1·58	β Chamæleontis, β Hydri	12 1	2 53·10	0·211	0·18
„ 14	3	E.	−11·6	[+0 6]	[−1·6]		12 5	2 56·78	0·153	0·14
„ 15	3	E.	−11·9	[+0·7]	[−1·6]		9 46	2 59·52	0·126	0·12
„ 18	6	E.W.	−12·3	+1·1	−1·73	β Chamæleontis, β Hydri E.	11 58	3 8·11	0·116	0·12
„ 19	5	W.	−12·3	[+1·3]	−1·99	β Chamæleontis, β Hydri	11 29	3 11·00	0·123	0·13
„ 20	3	W.	−12·7	[+1·4]	[−2·4]		10 14	3 13·96	0·130	0·12
„ 21	4	W.	−12·2	[+1·6]	−2·73	δ² Chamæleontis, ρ³ Leonis	10 15	3 16·66	0·112	0·12
„ 22	5	W.	−12·5	[+1·7]	−2·73	β Chamæl., β Canum Venat.	11 47	3 19·82	0·124	0·15
„ 23	4	W.	−13·6	[+1·9]	−3 19	β Chamæl., β Canum Venat.	12 39	3 24·25	0·178	0·18
„ 24	4	W.	−11·4	[+2·1]	−3·17	β Chamæl., 31 Comæ Ber.	12 45	3 28·70	0·185	0·21

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1903.							H. M.	M. S.	S.	S.
May 25	3	W.	−11″·9	[+2″·2]	[−3″·7]		10 25	3 33·73	0·232	0·23
„ 26	6	W.E.	−13·3	+2·4	−4·26	41 Leonis Min., δ^2 Chamæl. W.	12 21	3 39·47	0·221	0·22
„ 28	2	E.	{ −13·8 −0·4 }	[+2·1]	[−0·9]		13 5	3 50·49	0·226	0·23
„ 29	5	E.	−3·4	[+1·9]	+0·84	β Chamæleon., 31 Comæ Ber.	12 4	3 55·97	0·239	0·23
June 4	2	E.	−4·3	[+0·9]	[−1·7]		13 5	4 19·53	0·162	0·13
„ 5	6	E.W.	−4·5	+0·7	−2·10	δ^2 Chamæleontis, p^3 Leonis E.	11 37	4 22·44	0·129	0·15
„ 6	5	W.	−3·3	[+0·6]	−0·55	β Chamæleon., 31 Comæ Ber.	12 38	4 26·61	0·167	0·16
„ 7	3	W.	−4·1	[+0·4]	−1·62	δ Bootis, ρ Octantis	15 18	4 30·90	0·161	0·18
„ 8	3	W.	−4·6	[+0·3]	[−1·6]		12 41	4 35·05	0·194	0·20
„ 9	6	W.E.	−5·1	+0·2	−1·64	β Chamæl., β Canum V. W.	12 28	4 39·69	0·197	0·20
July 29	6	E.W.	{ −15·6 +0·4 }	+2·4	−0·63	ϵ Coronæ Borealis, δ^1 Apodis E.	16 21	8 58·71	0·215	0·18
Aug. 12	3	W.	+3·2	[−0·1]	−0·40	σ Octantis, θ Lyræ	19 17	9 56·08	0·169	0·18
„ 13	5	W.E.	+1·6	−0·3	+0·24	δ^1 Apodis, β Herculis W.	16 54	9 59·91	0·177	0·18
„ 15	4	E.	+0·7	[−0·8]	−2·54	σ Octantis	17 26	10 9·27	0·193	0·18
„ 16	4	E.	+0·6	[−1·0]	[−0·1]		17 38	10 13·48	0·174	0·16
„ 17	4	E.	+0·7	[−1·3]	[+2·4]		17 30	10 17·13	0·153	0·16
„ 18	6	E.W.	+0·5	−1·5	+4·84	ζ Pavonis, β Lyræ W.	17 41	10 21·39	0·176	0·19
„ 20	5	W.	+0·5	[+0·5]	+2·24	o Herculis, ζ Pavonis	17 44	10 31·87	0·218	0·21
„ 22	4	W.	+2·6	[+0·5]	−0·31	σ Octantis	17 24	10 41·87	0·210	0·23
„ 23	5	W.	+2·6	[+1·0]	+0·85	α Tri. Australis, κ Ophiuchi	17 6	10 47·69	0·246	0·24
„ 24	6	W.E.	+1·9	+1·5	{ +1·68 −0·01 }	{ ζ Pavonis, β Lyræ E. σ Octantis, θ Lyræ E. }	18 30	10 53·46	0·227	0·22
„ 29	3	E.	+2·1	[+1·3]	−1·57	σ Octantis	18 27	11 18·35	0·208	0·20

INSTRUMENTAL ERRORS AND CHRONOMETER ERRORS AND RATES—*Continued.*

Mean Solar Day.	No. of Star Transits.	Clamp E. or W.	Instrumental Errors. Level.	Instrumental Errors. Collimation.	Instrumental Errors. Azimuth.	Stars Employed for Azimuth Error.	Mean of Transits per Chronometer.	Chronometer Fast on Sidereal Time at Mean of Transits.	Hourly Gain in Preceding Interval.	Adopted Hourly Rate at Mean of Transits.
1903.			″	″	″		H. M.	M. S.	S.	S.
Sept. 1	3	E.	+ 1·7	[+1·2]	+2·46	1 Aquilæ, σ Octantis	18 34	11 32·38	0·195	0·15
„ 2	6	E.W.	+ 1·0	+1·2	+1·22	γ Lyræ, σ Octantis W.	18 25	11 35·72	0·140	0·15
„ 3	3	W.	+ 0·8	[+1·1]	+1·14	o Herculis, σ Octantis	18 10	11 39·51	0·160	0·16
„ 4	3	W.	+ 2·9	[+1·1]	−0·06	1 Aquilæ, σ Octantis	18 28	11 43·49	0·164	0·17
„ 5	4	W.	+ 2·4	[+1·0]	+2·95	1 Aquilæ, σ Octantis	18 24	11 47·76	0·178	0·19
„ 7	3	W.	+ 1·7	[+0·9]	[+1·9]		18 35	11 57·64	0·205	0·23
„ 8	4	W.	+ 2·4	[+0·8]	+1·31	σ Octantis	17 25	12 3·24	0·245	0·24
„ 9	2	W.	+ 1·6	[+0·8]	[+1·4]		18 38	12 9·02	0·230	0·22
„ 10	7	W.E.	+ 1·0	+0·7	+1·48	σ Octantis, θ Lyræ E.	18 55	12 14·05	0·207	0·20
„ 12	3	E.	+ 2·7	[+0·8]	+1·42	σ Octantis, θ Lyræ	19 19	12 23·56	0·196	0·22
„ 13	3	E.	+ 3·4	[+0·9]	+1·83	1 Aquilæ, σ Octantis	18 24	12 28·80	0·227	0·26
„ 14	4	E.	+ 3·1	[+0·9]	+1·61	σ Octantis	17 29	12 35·45	0·288	0·29
„ 20	5	E.W.	+ 4·0	+1·2	+5·37	σ Octantis, θ Lyræ W.	18 52	13 14·95	0·272	0·26
„ 21	4	W.	+ 3·9	[+1·1]	+3·06	σ Octantis, θ Lyræ	18 39	13 21·01	0·256	0·25
„ 23	2	W.	+ 4·3	[+1·0]	[+2·9]		20 52	13 32·41	0·226	0·22
Oct. 9	8	W.E.	+ 7·7	+0·2	+1·60	ζ Cygni, λ^1 Octantis E.	20 54	14 38·66	0·173	0·17
Dec. 31	2	E.	+11·0	[+3·1]	[+4·8]		2 24	19 9·78	0·137	0·09
1904.										
Jan. 3	6	E.W.	+ 9·8	+3·2	+4·89	μ Hydri, σ Arietis W.	2 49	19 16·36	0·091	

NOTES.

1903.
January 4— The chronometer ran down and was re-started.
January 7— The eastern pivot was lowered 10·6″ after the transits.
February 21—The collimator wire was accidentally destroyed, so that the usual method for determining the collimator error could not be employed
March 20— The chronometer ran down and was re-started on the 22nd.
May 28— The eastern pivot was lowered 13·4″ after the transits.
July 29— The eastern pivot was lowered 16·0″ before the transits.

Extra-Meridian Work.

Planet Observations.—Micrometer comparisons were made as follow with the 8-inch equatorial:—

Planet.	Nights of Observation.	Number of Comparisons.	Number of Comparison Stars.
(17) Thetis ...	... 5 ...	... 77 ...	... 1
(29) Amphitrite	... 4 ...	... 45 ...	... 2
(324) Bamberga	... 23 ...	... 236 ...	... 10

The observations of the first two planets have already appeared in the *Astronomische Nachrichten*, and those of the last in the *Monthly Notices* of the Royal Astronomical Society. Mr. C. J. Merfield has kindly compared the former observations with the ephemerides.

Comet Observations.—Two comets have been observed during the year with the 8-inch equatorial, as follow:—

Comet.	Nights of Observation.	Number of Comparisons.	Number of Comparison Stars.
1902 III. (Perrine)	... 13 ...	... 159 ...	... 13
1903 III. (Grigg)	... 16 ...	... 138 ...	.. 18

The observations of Comet 1902 III. were a continuation of a series commenced in November and December, 1902, and referred to in the last annual Report. The comet was chiefly observed in the morning sky. On April 21 a telegram appeared in the *Sydney Morning Herald*, announcing the discovery of Comet 1903 III. by Mr. John Grigg, of Thames, New Zealand, but without furnishing any positions, and it was not till April 25 that I received a letter from the discoverer, giving rough places for April 17 and 18. By these means I was enabled to find the visitor on April 25. The first four positions secured were cabled to Kiel, from which an approximate orbit was computed by Dr. Kreutz and Herr Ebell. The elements agreed closely with those already computed by Mr. C. J. Merfield from the same observations. The observations of both comets have already appeared in the *Astronomische Nachrichten*.

Meteorological Observations.

The following is an abstract of the meteorological results for 1903:—

1903.	Temperatures.				Rainfall.			
	Highest Shade.	Lowest Shade.	Highest in Sun, Black Bulb in Vacuo.	Lowest Radiation on Grass.	Guage 6·6 feet above Ground.	Guage 23·0 feet above Ground.	Greatest Daily Fall by Lower Guage.	Date 9h. a.m.
	°	°	°	°	Inches	Inches	Inches	
January	108·8	51·5	155·4	45·8	2·307	2·118	0·630	27
February	109·1	51·6	162·0	45·4	0·498	0·467	0 300	18
March	105·5	55 8	154·0	50·6	2·863	2·706	0 784	5
April	98·2	42·3	138·1	38·1	2·632	2·446	0·580	13
May..	76·0	30·4	126·2	29·0	2·359	2·187	0·940	9
June	69·5	24·2	111·8	22·4	0·993	0·886	0·330	2
July..	74·5	27·5	118 7	23·9	2·550	2·428	1·332	26
August	74·3	33·2	122·7	27·7	2·520	2·429	0 830	27
September	88·4	36 8	135·7	31·5	3·482	3·352	1·637	18
October	85·4	43·1	139·8	37·8	3·050	2·937	1·489	23
November	99 8	43·5	155·0	39·6	1·010	0·936	0·226	12
December	97·5	50·8	150·9	45·5	4·806	4·592	1·679	7
Year	109·1	24·2	162·0	22·4	29·070	27·484	1·679	Dec.7

In connection with these observations, it may be mentioned that during the year the River and South Creek were recorded as being disturbed on three occasions only. Small freshes occurred in August, September, and December. A plague of caterpillars was experienced in November, which was followed on the morning of November 26 by a flight of myriads of white butterflies. They travelled eastwards with the wind.

Publications.

The following papers have been published in astronomical journals since the last annual Report:—

Observations of Pallas, Amphitrite, and Comet 1902 III. (Perrine) in 1902 - 3.—*Astronomische Nachrichten*, Band 163, p. 293.

Observations of Thetis and Comet 1903 III. (Grigg) in 1903.—*Astronomische Nachrichten*, Band 163, p. 297.

Results of Double-Star Measures with the 8-Inch Equatorial in 1902.—*Royal Astronomical Society's Monthly Notices*, Vol. 64, p. 58.

Observations of Bamberga in 1903.—*Royal Astronomical Society's Monthly Notices*, Vol. 64, p. 558.

Observations Recently Utilised.

The equatorial observations of minor planet (7) *Iris*, made in 1898, have been employed by Dr. J. Riem in his Verbesserung und Ergänzung der Brünnow'schen Tafeln der Iris. See *Veröffentlichungen des königlichen astronomischen Rechen-Instituts zu Berlin*, No. 20, p. 87.

The observations of Comet 1889 IV. (Davidson) have been employed by Dr. Guido Horn of Trieste, with those made at 29 other observatories, in the definitive determination of the orbit of the Comet. See *Astronomische Nachrichten*, Band 165, p. 327.

The Library.

Fifty-eight public institutions and ten individuals have contributed their publications to the library during the year, to whom the author presents his best thanks. For the future, instead of publishing a list of the presents received, the author will at the close of each year send an acknowledgment by post to the donors.

Conclusion.

The author, having now attained his seventieth year, finds that he is compelled to discontinue systematic work. His declining years will be devoted to business of a private nature, with occasional attention to astronomical observation. The present Report will therefore conclude the series emanating from his Observatory.

PRESENTS RECEIVED FOR THE LIBRARY DURING THE YEAR 1903.

[NOTE.—The names of the donors are printed in italics.]

Results of Rain, River, and Evaporation Observations in N. S. Wales in 1900, with maps and diagrams; pp. lxvi.. 139.
The Government Observatory, Sydney.

Meteorological Observations at the Adelaide Observatory and other places in South Australia and the Northern Territory during 1899; pp. xvi., 95 and 91, with maps.
The Government Observatory. Adelaide, S.A.

Meteorological Observations at the Perth Observatory and other places in Western Australia during 1901; pp. 135, with maps.
The Government Observatory, Perth, W.A.

"Wragge."—Official Journal of the Central Weather Bureau, Brisbane, Vol. I., Nos. 1 – 24, July – Dec.. 1902; also Weekly Numbers from April 16 to July 9, 1903, both included.
The Central Weather Bureau, Brisbane, Queensland.

The Surveyor for 1902, Dec. 31; 1903, Jan. 31, Feb. 28, March 31, May 7, June 4, July 8, Aug. 8, Sept. 11, Oct. 19, Nov. 10, 25, and Dec. 23. *The Institution of Surveyors, N.S. Wales.*

The Hawkesbury Agricultural College Magazine, Vol. II., No. 17, part 12. *The Hawkesbury Agricultural College.*

Queensland Geographical Journal (new series), 18th Session, 1902 – 1903; pp. 176.
The Queensland Branch of the R. Geographical Society of Australasia.

The Mirror, Vol. I., 1903, April, July, and October.
Summer Hill Parliamentary Debating Society.

Results of Micrometer Measures of Double-Stars with the 28-inch Refractor at the Royal Observatory, Greenwich, in 1902; pp. 403 – 419. *The Royal Observatory, Greenwich.*

Weekly Weather Reports, 1902 Nov. 22, to 1903 Nov. 14, complete except that for 1903 Feb. 28.

Quarterly Summaries of the Weekly Weather Report, 1902, Oct. – Dec., and 1903, July – Sept.

Summary of the Weekly Weather Report, 1902: Values for the year.

Weekly Weather Report, 1902, Vol. XIX., App. II.: Rainy Days .. 1902.

Title Page and Preface to the Weekly Weather Report for 1902.

Meteorological Observations at Stations of the Second Order for 1899; pp. xiii., 182.

Hourly Means from the Self-Recording Instruments at the Five Observatories under the Meteorological Council, 1899, pp. xi., 239.

Summary of Observations made at 117 Stations in the United Kingdom for 1902, Oct., Nov., Dec. 1903, Jan. (two copies): at 119 Stations for 1903, Feb. at 120 Stations for 1903, March, April, May, at 121 Stations for 1903, June, and at 120 Stations for 1903, July, Aug., and Sept.

Report of the Meteorological Council for the Year ending 1902, March 31; pp. 163. *The Meteorological Office, London.*

28th Annual Report of the Savilian Professor of Astronomy for 1902 – 1903; pp. 12. *The University Observatory, Oxford.*

Report of the Library Syndicate for 1902; pp. 24. *The University, Cambridge.*

Report of the Liverpool Observatory, Bidston, Birkenhead, and Meteorological Results for 1902; pp. 43. *The Liverpool Observatory.*

Reports of the National Physical Laboratory for 1901 and 1902; pp. 54 and 51. *The National Physical Laboratory.*

Results of Meteorological and Magnetical Observations at Stonyhurst College Observatory, with Report, etc., 1902; pp. vi., 76. *The Stonyhurst College Observatory.*

Report and Results of Observations at the Fernley Observatory, Southport, for 1902; pp. 30.

The Meteorology of Southport, by Joseph Baxendell, F.R.Met.S.; pp. 12. *The Fernley Observatory, Southport.*

Rousdon Meteorological Observations for 1902; pp. 16. *The Rousdon Observatory, Devon.*

Report of the Royal Observatory, Cape of Good Hope, for 1902; pp. 16.

Independent Day-Numbers for 1905, as used at the Royal Observatory, Cape of Good Hope; pp. 14. *The Royal Observatory, Cape of Good Hope.*

Report of the Government Astronomer at Natal for 1902; pp. 75. *The Natal Observatory.*

Report of the Kodaikanal and Madras Observatories for 1902; pp. 22. *The Kodaikanal and Madras Observatories.*

Observations at Hongkong Observatory in 1902; pp. 10 and (127). *The Hongkong Observatory.*

Report on the Total Solar Eclipse of 1898, January 21 – 22, as observed at Jeur, in Western India, by K. D. Naegamvala, M.A., etc.; pp. vi., 73, with plates. *The Government of Bombay.*

Report of the Meteorological Service of Canada for 1901; pp. xxiii., 369.

Monthly Weather Review, 1902 Sept., Nov., Dec., 1903 January to August (inclusive).

Toronto General Meteorological Register for 1902; pp. 12. *The Meteorological Office, Toronto.*

Smithsonian Miscellaneous Collections, 1259. List of Observatories, 1902; pp. 48. *The Smithsonian Institution.*

Report of the U.S. Naval Observatory for the Year ended 1902, June 30; pp 38.

Publications of the U.S. Naval Observatory (2nd series), Vol. II., pp. xxviii., 525.

Meteorological Observations and Results at the U.S. Naval Observatory, 1891 – 1892; pp. 63. *The U.S. Naval Observatory, Washington.*

Bulletins of the Lick Observatory, Nos. 27 - 36, 38 - 40, 44 – 48.

Title Page, Contents, etc., to Vol. I., Nos. 1 – 26, 1901 - 1902, of the Lick Observatory Bulletins. *The Lick Observatory.*

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J. T. Ward, Wanganui, N.Z.

ERRATA.

REPORT FOR 1902, page 3.

In the 2nd and 7th lines from the bottom, *for* C and D, *read* D and E respectively.

MEMORANDUM.

The following publications have been issued directly from this Observatory, and only a few copies remain of some of the issues:—

No.				
1.	Windsor Meteorological Observations for 1863-64-65-66.			
2.	„	„	„	„ 1867-68-69-70.
3.	„	„	„	„ 1871-72-73-74-75-76.
4.	„	„	„	„ 1877-78-79-80-81.
5.	„	„	„	„ 1882-83-84-85.
6.	„	„	„	„ 1886-87-88-89-90.
7.	„	„	„	„ 1891-92-93-94-95-96-97.

8. History and Description of Mr. Tebbutt's Observatory, Windsor, to the close of 1887.

No.				
9.	Report of the Observatory for		... ...	1888.
10.	„	„	„	1889.
11.	„	„	„	1890.
12.	„	„	„	1891.
13.	„	„	„	1892.
14.	„	„	„	1893.
15.	„	„	„	1894.
16.	„	„	„	1895.
17.	„	„	„	1896.
18.	„	„	„	1897.
19.	„	„	„	1898.
20.	„	„	„	1899.
21.	„	„	„	1900.
22.	„	„	„	1901.

23.—The Sydney Observatory and the *Sydney Morning Herald*—A Plea for Astronomy in New South Wales.

Be good enough to rule through the titles of such of the above works as you have in the Library of your Institution, and return to me the memorandum by an early mail.

JOHN TEBBUTT.

The Observatory,
Windsor, N. S. Wales,
1902, April 12.